

★

SYSTEM OF MINERALOGY

IN WHICH
MINERALS ARE ARRANGED ACCORDING TO
THE NATURAL HISTORY METHOD.

BY
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TO

ROBERT FERGUSON, Esq.

OF RAITH,

FELLOW OF THE ROYAL SOCIETIES OF LONDON AND EDINBURGH

MEMBER OF THE GEOLOGICAL SOCIETY, OF THE

WERNERIAN NATURAL HISTORY SOCIETY, &c.

IN TESTIMONY

OF HIS

DISTINGUISHED TALENTS AS A MINERALOGIST,

BY HIS

FAITHFUL AND SINCERE FRIEND

THE AUTHOR.

PREFACE.

MINERALOGY, although a science of comparatively modern date, has, within a short period of time, made rapid advances. It was first successfully cultivated in Germany and Sweden, and afterwards in France. In Great Britain, so distinguished in all the other sciences and arts of life, it was, until lately, almost entirely neglected. Now, however, it has become with us a subject of general interest and attention, and, like Chemistry, is considered as a necessary branch of education. The establishment of Lectureships and Societies, having Mineralogy as one of their principal objects, is a strong proof of the public feeling of the importance and utility of this science. Within a few years, several of the Universities have founded Professorships of Mineralogy; and that munificent and patriotic association, the Honourable Dublin Society, has lately added to its establishment a Lecturer on this science. This example has been followed by other public bodies, and also by private associations.

The establishment of the Wernerian Natural History Society of Edinburgh in 1808, directed, in this part of the

empire, the particular attention of naturalists to Mineralogy; the labours of the Geological Society of London have created a 'new era in the geology of England; and the lately established Royal Geological Society of Cornwall, is making us acquainted with the mineralogical structure of one of the most interesting portions of England. But the present enthusiasm displayed throughout this country in the study of Mineralogy, is not entirely owing to the exertions of teachers, and the spirit excited by Societies: it has been also fostered, encouraged, and directed, by the writings of individuals. Of these, the most eminent is KIRWAN, whose System of Mineralogy excited very general attention, was long the standard book on this subject, and has been of infinite benefit to Mineralogy. Since the publication of the second and most valuable edition of that work, and which contained the first English account of the Wernerian System, several other authors have, by their writings, directed the studies, and assisted the labours of mineralogists. Among these, Dr KID of Oxford has distinguished himself, as the author of a treatise, entitled, "Outlines of Mineralogy." Dr THOMSON, in his System of Chemistry, has dedicated a volume to the science of Mineralogy, in which that distinguished chemist has proposed several judicious improvements in the prevailing mineralogical systems; and Dr MURRAY, in his System of Chemistry, gives a view of the natural characters and chemical properties of the different species, adopting the chemical arrangement. ARTHUR AIKIN, Esq. Secretary to the So-

ciety of Arts of London, has published a useful “Manual of Mineralogy.” And the work now presented to the public attention, professes to have the same claims and intentions.

The arrangement adopted in this edition of the System, is nearly that of my celebrated friend MOHS, who now fills the Mineralogical Chair of the illustrious WERNER. It is founded on what are popularly called the External Characters of Minerals, and is totally independent of any aid from Chemistry. This, which may be termed the *Natural History Method*, I have always considered as the only one by which minerals could be scientifically arranged, and the species accurately determined. In my Lectures on Mineralogy, I have been in the practice of grouping minerals together, according to their forms, lustre, streak, hardness, and specific gravity, with the view of shewing to my pupils how they could thus be arranged and determined, without the assistance of chemistry, and in conformity with the Natural

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History

* “The want of a true systematic arrangement of minerals, is still to be regretted; for although mineralogists, from the days of THEOPHRASTUS to the present time, have been engaged in this undertaking, their success has been very limited. In Botany and Zoology, regular methods have been proposed and followed; in Mineralogy, however, the greater number of writers, excepting LINNÆUS and Dr WALKER, have discarded the idea of a strict natural history arrangement, from its supposed insufficiency. This opinion, there can be no question, is ill-founded; for, it will be found on a strict investigation, that minerals can be admirably arranged into Classes, Orders, Genera, and Species.”—*Introduction to Mineralogy of the Shetland Islands*, p. 2. and 3.

History method employed by Zoologists and Botanists. According to this view, I separated all the earthy-looking minerals, such as Olivenite, Copper-mica, Lead-spar, Malachite, &c. from the Metalliferous Class, and arranged them with those Earthy Minerals to which they were most nearly allied in lustre, hardness, specific gravity, and other characters; and in the metalliferous class, arranged the different genera into groupes, or orders, forming the native metals into one order, the pyrites into another, and other metalliferous minerals into similar groupes. I was proceeding in this mode of arranging all the minerals in the System, when Professor MOHS paid me a visit in Edinburgh, and there explained to me his profound views on classification. I found they were of the same general nature with those I entertained, but that he had advanced much further, and, by the discovery of a system of Crystallography, eminently distinguished by its originality and simplicity, had been enabled to give to the Natural History Method a certainty even superior to that which exists in Botany and Zoology †.

In

* A consistent and satisfactory chemical arrangement of minerals, notwithstanding the late ingenious attempt of BERZELIUS, is still a desideratum in Mineralogy. It would seem that our knowledge of the chemistry of minerals is very far from being perfect; and various facts render it probable that many of the analyses must be again repeated, before any satisfactory arrangement can be proposed.

† The Mineral System, as it appears in this work, is to be considered as realising those views which WERNER entertained in regard to the mode of arranging and determining minerals. He was convinced of the utter impossibility of constructing a truly philosophical mineralogical system, in which the External and Chemical Characters were to be conjoined, and considered the mixed method he delivered in his lectures, as merely a tempora-

In another Treatise which I purpose laying before the public, a full statement will be given of Professor MOHS's views. In the mean time, the few observations prefixed to the *Characteristic View* of the Classes, Orders, Genera, and Species, will enable the reader to understand the nature of the system, as far as it is employed in the present work.

The *Descriptions* of the Species, Subspecies, and Kinds, are on the same plan as in the former editions, but are considerably improved, particularly in what regards cleavage, hardness, and specific gravity; in which details I have much pleasure in acknowledging the valuable information I derived from Professor MOHS.

As the Geognostical Characters of the Species lead to very interesting views in regard to the formation of Simple Minerals, and also to that of the Globe in general, I have carefully enumerated all that is known in regard to their distribution in the crust of the Earth; and to complete this view, their geographical distributions are also delineated. Although the Chemical Characters and composition of simple minerals are not employed in arranging and determining the species, still it is necessary for the mineralogist to be acquainted with them, and therefore, these also are enumerated. The Uses of Minerals are as fully detailed as is required in a work like the present; and the account

ry arrangement. He felt that the Natural History Method must be introduced into Mineralogy, if Orvetochnow was to hold the same rank in the

count of each Species is concluded by a statement of its popular distinctive characters and various miscellaneous particulars, in regard to its name, discoverer, &c.

I have again, as in former editions of this work, the pleasure of acknowledging the advantages I derived from the information and communications of friends, particularly from the numerous facts transmitted to me by Mr HEVLAND.

EDINBURGH, }
November 1819. }

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LIST

OF

WORKS

Quoted in this Treatise, and of the Abbreviated Titles employed.

Names of Authors.	Titles of the Works.	Abbreviated Titles.
Theophrastus.	Περὶ λίθων, History of Stones, with an English version, and notes, including the modern history of the gems described by that author. By Sir John Hill. London, 1774.	Theophrastus.
Plinius.	C. Plinii sec. Historiæ Naturalis libri xxxvii. ; quos interpretatione et notis illustravit J. Harduinus, Paris 1732, t. iil. fol. C. Plinii sec. Hist. Nat. libri xxxvii. ex recensione J. Harduine, Studius Societ. Bipont. 1783, 1784. Basil, 1546, fol.	Plin.
Agricola.	G. Agricola de Re Metallica L. xii. et de natura Fossilium l. x. &c. Basil, 1546, fol.	Agricola.
Bacci.	De Gemmis et Lapidibus pretiosis, 1611.	
Boetius de Boot.	Gemmarum et Lapidum Historia, 1647,	
Boyle.	An Essay about the original Virtues of Gems, wherein are proposed, and historically illustrated, some conjectures about the consistence of the matter of precious stones, and the subjects wherein their chiefest virtues reside. By the Honourable Robert Boyle,	

Names of Authors.	Titles of the Works.	Abbreviated Titles.
Wallerius.	Jo. Gottschalk ^{us} Wallerii Systema mineralogicum, 8vo.	Wall.
Linnaeus.	Linné System. Naturæ, t. iii. cura J. F. Gmelin, Lipsiæ, 1793.	Lin.
Brückmann.	Urban Friederick Benedict Brückmann's Abhandlung von Edelsteinen, 2te Ausgabe. Braunschweig, 1773. U. F. B. Brückmann's Beiträge zu seiner Abhandlung von Edelsteinen. Braunschweig, 1778. U. F. B. Bruckmann's Gesammlete und eigene Beiträge zu seiner Abhandlung von Edelsteinen. Braunschweig, 1783.	
Dutens.	Dutens des Pierres precieuses, et des Pierres fines, avec les moyens de les connoître. A Paris & Bâle, 1778, 8vo.	
Romé de Lisle.	Cristallographie ou Description des formes propres à tous les corps du regne mineral. Avec figures et tableaux synoptiques de tous les cristaux connu. Par M. De Romé de Lisle, 2de edit. Paris 1783, 4. t. 8vo.	R. de L.
Bergmann.	Torb. Bergmann's Sciagraphia regni mineralis, secundum principia proxima digesti. Manuel du Mineralogiste, ou Sciagraphie du regne mineral, distribué d'après l'analyse chimique, par M. Torb. Bergmann, traduite et augmentée des notes par Monge. A Paris, 1784.	Bergmann.
La Methérie	Theorie de la Terre, t. i. et ii. 1797.	Lam.
Kirwan.	Elements of Mineralogy, by Richard Kirwan, Esq. President of the Royal Irish Academy, &c. 2 vols 8vo. 1794—96.	Kirw.
Napione.	Elementi di Mineralogia, 1 vol. 8vo. Turin, 1797.	Nap.
Werner.	Cronstedt's Versuch einer Mineralogie übersetzt, 1 vol. 8vo. Leipsic, 1780.	Wern. Cronst.
Idem.	Ausführliches und systematisches Verzeichniss des Mineralien-kabinet des Pabst von Ohain, 2 vols 8vo. Freyberg, 1791, 1792.	Wern. Pabst.

Names of Authors.	Titles of the Works.	Abbreviated Titles.
De Born.	Catalogue methodique et raisonne de la collection des Fossiles de Mademoiselle Eleonore de Raab. Vienne, 1790.	De Born.
Saussure.	Voyages dans les Alpes, par Horace Benedict Saussure. 4 vols 4to, 1779, 1796.	Saussure.
Wiedenman	Wiedenman's Handbuch der Oryctognostischen Theils der Mineralogie. Leipzig, 1794, 8vo.	Wid.
Reuss.	Lehrbuch der Mineralogie nach des H. O. B. R. Karsten Tabellen, von F. Ambros Reuss, 4 vols 1803, 1808.	Reuss.
Haüy.	Traité de Mineralogie par Haüy, 4 vols. Paris 1801.	Haüy.
Brochant.	Traité elementaire de Mineralogie, suivant les principes du Professor Werner, 2 vols. Paris, an ix.	Broch.
Ludwig.	Handbuch der Mineralogie nach Werner, von C. F. Ludwig, Professor in Leipzig, 2 vols, 1803, 1804.	Lud.
Suckow.	Suckow's Anfangsgründe der Mineralogie nach der neuesten Entdeckungen. Leipzig, 1803.	Suck.
Bertele.	Bertele's Handbuch der Minerographie. Landshut, 1804.	Bert.
Mohs.	Der Herr von der Null mineralien-kabinet nach einem, durchaus auf aussere Kennzeichen gegründeten Systeme geordnet, Beschrieben, &c. von F. Mohs, 3 bände. Vien. 1804,	Mohs.
Haberle.	Characterisende Darstellung der Mineralien mit hinsicht auf Werner et Many's Beobachtungen, von Dr Carl Const. Haberle. Weimer, 1806, 8vo.	Hab.
Lucas.	Tableau Methodique des Especies Minerales, par J. A. Lucas. Premiere partie, Paris 1806. Seconde partie. Paris 1813.	Lucas.
Leonhard.	Systematisch-tabellarische, Übersicht et Characteristik der Mineral Körper, von C. C. Leonhard, K. F. Merz, et Dr J. H. Kopp. Frankfurt am Maine, 1806, fol.	Leonhard, Tabel.

Names of Authors.	Titles of the Works.	Abbreviated Titles.
Brard.	Manuel du Voyageur et du Geologue Voyager, par C. P. Brard, 8vo, Paris 1808.	Brard.
	Traité des Pierres Précieuses, &c. 8vo, Paris 1808.	
Karsten.	Mineralogische Tabellen mit Rücksicht auf die neuesten Entdeckungen aufgestellt und mit erläuternden anmerkungen versehen, von D. L. G. Karsten. Berlin, 1808, fol.	Karsten, Tabel.
Hausmann.	Entwurf eines Systems der unorganischen Natur Körper, von J. F. L. Hausmann. Cassel, 1809, 8vo.	Haus.
Kidd.	Outlines of Mineralogy, by J. Kidd, M.D. Professor of Chemistry in the University of Oxford. 2 vols 8vo. Oxford, 1809.	Kidd.
Haüy.	Tableau Comparatif des Resultats de la Cristallographie et de l'analyse chimique relativement à la Classification des Minéraux, par M. l'Abbé Haüy. 8vo, Paris 1809.	Haüy, Tabl.
Lenz.	Erkenntnisslehre der anorgischen Natur Körper, von Dr J. G. Lenz. Giessen, 1813.	Lenz.
Hoffmann.	Handbuch der Mineralogie, von C. A. S. Hoffman, 1811, 1818, 4 bände.	Hoff.
Oken.	Oken's Lehrbuch der Naturgeschichte 1ter Theil Mineralogie. 8vo, Leipzig, 1813.	Oken.
Bournon.	Catalogue de la Collection Mineralogique du Comte de Bournon. Londres, 8vo, 1813.	Bournon.
Hausmann.	Handbuch der Mineralogie von Joh. Friedr. Ludw. Haussmann, 3 bände 8vo. Göttingen 1813.	Haus. Handb.
Aikin.	A Manual of Mineralogy. By Arthur Aikin, Secretary to the Geological Society, London, 1815.	Aikin.
Steffens.	Vollständiges Handbuch der Oryktognosie. Halle, 1811, 1815.	Steff.
Cleaveland.	Cleaveland's System of Mineralogy and Geology, 1 vol. Boston, 1816.	Cleav.

Names of Authors.	Titles of the Works.	Abbreviated Titles.
	<i>JOURNALS, &c. referred to.</i>	
Gehlen,	A. F. Gehlen's Neues allgemeines Journal der Chemie. Berlin, 1803, 1806, 6 bände 8vo.	Gehlen.
Schweigger.	J. C. Schweigger's Journal für Chemie und Physik. Nürnberg, since 1811, 8vo.	Schweigger.
Journal de Physique.	J. C. de Lamethrie, Journal de Physique, de Chimie, et d'Histoire Naturelle. A Paris.	Journ. d. Phys.
Bergmännische's Journal.	Bergmännische's Journal, herausgegeben von Köhler und Hoffman. Freyberg.	Bergm. Journ.
Leonhard.	Leonhard's Taschenbuch für die gesammte Mineralogie, 1807 to 1815.	Leonhard, Taschenbuch.
Moll's.	Ehrenberg. Freiherrn von Moll's Jahrbücher der Berg und Hüttenkunde, Salzburg, 1797, 1801, 5 bände 8vo.	
	——— Annalen der Berg und Hüttenkunde, Salzburg, 1801—1805, 3 bde 8vo.	
	——— Ephemeriden der Berg und Hüttenkunde, Nürnberg, 1805—1809, 5 bde.	
	——— Neue Jahrbücher der Berg und Hüttenkunde, Nürnberg, since 1808, 8vo.	
Journal des Mines.	Journal des Mines, publié par le Conseil des Mines à Paris. Since 1794, in 8vo numbers.	Journ. d. Min.
Annales du Museum.	Annales du Museum d'Histoire Naturelle; à Paris. Since 1802, in 4to numbers.	Annal. d. Mus.
Weber & Mohr.	Friedr. Weber's und D. M. H. Mohr's Archiv für die Systematische Naturkunde. Leipzig, 1804, 8vo. As continuation of this work,	Weber & Mohr.
	——— Beiträge zur Naturkunde, Kiel, 1805—1810, 2 bde 8vo.	

Names of Authors.	Titles of the Works.	Abbreviated Titles.
<p>Hisinger and Berzelius.</p> <p>Magazin Naturforschender Freunde, Klaproth.</p>	<p>Afhandlingar i Fysik, Kemi, och Mineralogi, Utgifne af W. Hisinger och J. Berzelius, Stockholm, 1806—1810.</p>	
	<p>Magazin der Gesellschaft Naturforschender Freunde zu Berlin. Since 1807, in 4to numbers.</p>	<p>Magaz. Gesel. Nat. f. Fr.</p>
	<p>Klaproth's Beiträge zur Chemischen Kenntniss der Mineral Körper, Berlin. 1795—1810, 5 bde 8vo.</p>	<p>Klap. Beit.</p>
	<p>J. F. John, Zwei Fortsetzungen des Chemischen Laboratoriums, unter d. Titel. Chemische untersuchungen mineralischer, vegetabilischer, und animalischer Substanzen, Berlin, 1810, 1811, 2 bde 8vo.</p>	
	<p>Thomson's Annals of Philosophy.</p>	
	<p>Transactions of the Royal Society of London.</p>	
	<p>Transactions of the Geological Society.</p>	
	<p>Transactions of the Royal Society of Edinburgh.</p> <p>Memoirs of the Wernerian Natural History Society.</p> <p>Transactions of the Royal Geological Society of Cornwall.</p>	

TABULAR

TABULAR VIEW
OF
SYSTEMS
OF
MINERALOGY,

Since the first Publication of the Arrangement of
LINNÆUS, A. D. 1736.

VOL. I.

b

LINNÆI (*Car.*) SYSTEMA NATURÆ, *Lugdb.* 1736, 1748.

I. PETRÆ.	II. MINERÆ.	III. FOSSILIA.
1. VITRESCENTES.	1. SALIA.	1. CONCRETA.
Cos	Natrum	Saxum
Quartzum	Selenites	Tophus
Silex	Nitrum	Stalactites
	Muria	Pumex
2. CALCARIÆ.	Alumen	Ætites
Marmor	Vitriolum	Tartarus
Spatum		Calculus
Schistus	2. SULPHURA.	
	Electrum	2. PETRIFICATA.
3. APYRÆ.	Bitumen	Helmintholithus
Mica	Pyrites	Entomolithus
Talcum	Arsenicum	Ichthyolithus
Amiantus		Ornitholithus
Asbestos	3. MERCURIALIA.	Zoolithus
	Hydrargyrum	Phytolithus
	Stibium	Graptolithus
	Zincum	
	Vismuthum	3. TERRÆ.
	Ferrum	Marga
	Stannum	Ochra
	Plumbum	Creta
	Cuprum	Argilla
	Argentum	Arena
	Aurum	Humus

LINNÆI (*Car.*) SYSTEMA NATURÆ, *Holm.* 1768.

I. PETRÆ.	II. MINERÆ.	III. FOSSILIA.
I. HUMOSÆ.	I. SALIA.	I. PETRIFICATA.
1. Schistus	13. Nitrum	36. Zoolithus
	14. Natrum	37. Ornitholithus
	15. Borax	38. Amphibiolithus
	16. Muria	39. Ichthyolithus
	17. Alumen	40. Entomolithus
	18. Vitriolum	41. Helmintholithus
		42. Phytolithus
		43. Graptolithus
II. CALCARIÆ.	II. SULPHURA.	II. CONCRETA.
2. Marmor	19. Ambra	44. Calculus
3. Gypsum	20. Succinum	45. Tartarus
4. Stirium	21. Bitumen	46. Aëtites
5. Spatum	22. Pyrites	47. Pumex
	23. Arsenicum	48. Stalactites
		49. Tophus
III. ARGILLACÆ.	III. METALLA.	III. TERRÆ.
6. Talcum	24. Hydragryum	50. Ochra
7. Amiantus	25. Molybdænum	51. Arena
8. Mica	26. Stibium	52. Argilla
	27. Zincum	53. Calx
	28. Vismuthum	54. Humus
	29. Cobaltum	
	30. Stannum	
	31. Plumbum	
IV. ARENATÆ.	32. Ferrum	
9. Cos.	33. Cuprum	
10. Quartzum	34. Argentum	
11. Silex	35. Aurum	
V. AGGREGATE.		
12. Saxum		

WALLERII (*J. G.*) MINERALOGIA, *Stockh.* 1747, 8v.

		Quartzum	3. SEMIMETALLA.
I. TERRÆ.		Crystallus	
1. MACRÆ.		3. APYRI.	Hydrargyrum
	Humus	Mica	Arsenicum
	Creta	Talcum	Cobaltum
2. PINGUES.		Ollaris	Antimonium
	Argilla	Corneus	Wismuthum
	Marga	Amiantus	Zincum
3. MINERALES.		Asbestus	4. METALLA.
	Salinæ	4. SAXA.	Ferrum
	Sulphuræ	Simplicia	Cuprum
	Metallicæ	Mixta	Plumbum
4. ARENACEÆ		Grisea	Stannum
	Arena	Petrosa	Argentum
	Glara		Aurum
	Metallicæ		IV. CONCRETA.
II. LAPIDES.	Animales	III. MINERÆ.	
		1. SALIA.	
		Vitriolum	
		Alumen	
		Nitrum	
		Muria	
		Alcalia	
		Acida	
		Neutra	
		Ammoniacum	
1. CALCARI.		Borax	
	Calcareus		
	Marmor		
	Gypsum		
2. VITRESCENTES.		2. SULPHURA.	
	Fissilis	Bitumen	
	Cos	Succinum	
	Silex	Ambra	
Petrosilex		Sulphura	
			1. PORI.
			Igni
			Aquei
			2. PETRIFICATA.
			Vegetabilia
			Corallia
			Animalia
			Testacea
			3. FIGURATA.
			Lithomorphi
			Lithoglyphi
			Lithotomi
			4. CALCULI.
			Vegetabilium
			Animalium

WALLERII (J. G.) SYSTEMA MINERALOGICUM,
Holm., 1772, 8vo.

I. TERRÆ.	3. FUSIBILES.	3. SEMIMETALLA.
1. MACRÆ.	Zeolithus	Mercurius
Humus	Basaltes	Arsenicum
Calcareæ	Magnesia	Cobaltum
Gypseæ	Schistus	Niccolum
Manganenses	Margodes	Antimonium
	Corneus	Wismuthum
		Zincum
2. TENACES.	4. APYRI. °	4. METALLA.
Argilla	Mica	Ferrum
Marga	Talcum	Cuprum
	Steatites	Plumbum
3. MINERALES.	Serpentinus	Stannum
	Ollaris	Argentum
4. DURÆ.	Asbestus	Aurum
Glarea	Amiantus	Platina
Tripela		
Carmentum	5. SAXA.	IV. CONCRETA
Arena	Mixta	1. PORI.
Ar. metallita	Aggregata	Igni
Ar. animalis		Aquei
	III. MINERÆ.	2. PETRIFICATA.
II. LAPIDES.	1. SALIA.	Vegetabilia
1. CALCAREI.	Acida	Corallia
Calcareus	Vitriolum	Zooli
Marmor	Alumen	Helmintholithi
Spatum	Nitrum	— testaceorum
Gypsum	Muria	Entomolothi
Fluor mineralis	Natron	Amphibiolithi
	Alc. volatile	Ichthyolithi
2. VITRESCENTES.	Neutra	Ornitholithi
Cos	Ammoniacum	Zoolithi
Spat. scintillans	Borax	Anthropolithi
Quartzum		3. FIGURATA.
Gemma	2. SULPHURA.	Lithomorphi
Granatus	Bitumen	Lithoglyphi
Silex	Succinum	Lithotomi
Petrosilex	Ambra	4. CALCULI.
Achates	Sulphur	Vegetabilium
Jaspis		Animalium

CRONSTEDT MINERALOGIA, *Stockh.* 1758, 8vo.

I. TERRÆ.	6. <i>Fluores.</i> Indurati	IV. METALLA.
1. <i>Calcareæ.</i> Puræ Vitriolacæ Phlogisticæ Argillacæ	7. <i>Asbestinæ.</i> Asbestus Amiantus	1. <i>Perfecta</i> Aurum Argentum Platina Stannum Plumbum Cuprum Ferrum
2. <i>Siliciæ.</i> Adamas Sapphirus Topazius Smaragdus Quartzum Silex Jaspis	8. <i>Zeolithicæ.</i> Zeol. purus Zeol. metallicus	2. <i>Semimetalla.</i> Hydrargyrum Wismuthum Zincum Antimonium Arsenicum Cobaltum Niccolum.
3. <i>Granatinæ.</i> Granatus Basaltes	9. <i>Magnesiæ.</i> Magnesia terrea Magnesia indurata	
4. <i>Argillacæ.</i> Porcellana Lithomarga Bolus Tripolitana Argilla	II. SALIA.	
5. <i>Micacæ.</i> Mica pura Mica martialis	1. <i>Acida.</i> Vitriolum Muria	
	2. <i>Alcalina.</i> Fixa Volatilia	
	III. PHLOGISTICA.	
	Ambra Succinum Petroleum Sulphur Phlogist. terreum — metallicum	

WALKER

CLASSIS FOSSILIUM.—*Edin.* 1789.Classis I.—*Terræ.*

Ord. 1. Figulinæ. Ord. 2. Fimosæ. Ord. 3. Calcareæ. Ord. 4. Absorbentes. Ord. 5. Gypsea. Ord. 6. Siliceæ. Ord. 7. Asperæ. Ord. 8. Steatiticæ. Ord. 9. Apyræ. Ord. 10. Lapideæ. Ord. 11. Inflammabiles. Ord. 12. Ochræ.

Classis II.—*Calcareæ.*

Ord. 1. Cementaria. Ord. 2. Dædalea. Ord. 3. Stiriacea. Ord. 4. Spata.

Classis III.—*Gypsea.*

Ord. 1. Plastica. Ord. 2. Selenitica.

Classis IV.—*Phosphorea.*Classis V.—*Zeolitica.*Classis VI.—*Ponderosa.*Classis VII.—*Amandina.*

Ord. 1. Shorlacea. Ord. 2. Garamantica. Ord. 3. Ignigena.

Classis VIII.—*Silicea.*

Ord. 1. Quartzosa. Ord. 2. Jaspidea. Ord. 3. Lithidea. Ord. 4. Gemmæ.

Classis IX.—*Steatitica.*

Ord. 1. Saponacea. Ord. 2. Ollaria.

Classis X.

Classis X.—*Apyra*.

Ord. 1. Amiantina. Ord. 2. Asbestina.

Classis XI.—*Micacea*.Classis XII.—*Petræ*.Ord. 1. Quadrinæ. Ord. 2. Cotacæ. Ord. 3. Schistosæ.
Ord. 4. Siliciæ.Classis XIII.—*Saxa*.Ord. 1. Calcarea. Ord. 2. Arenaria. Ord. 3. Porphyria.
Ord. 4. Granitæ. Ord. 5. Schistosa. Ord. 6. Amandina.
Ord. 7. Steatitica. Ord. 8. Amiantina. Ord. 9. Micacea.
Ord. 10. Metallica.Classis XIV.—*Concreta*.Ord. 1. Terrestris. Ord. 2. Aquea. Ord. 3. Ignea. Ord. 4.
Metallica.Classis XV.—*Salia*.Ord. 1. Acida. Ord. 2. Alcalina. Ord. 3. Acido-alcalina.
Ord. 4. Acido-terrea. Ord. 5. Alcalino-terrea. Ord. 6. Vi-
triola.Classis XVI.—*Inflammabilia*.Ord. 1. Acria. Ord. 2. Sulphurea. Ord. 3. Bitumina. Ord. 4.
Carbonaria. Ord. 5. Electrica.Classis XVII.—*Pyritæ*.Ord. 1. Sulphuræ. Ord. 2. Arsenicales. Ord. 3. Ferreæ.
Ord. 4. Amandinæ.Classis XVIII.—*Semi-metallica*.Ord. 1. Arsenicalia. Ord. 2. Sulphurea. Ord. 3. Fluida.
Ord. 4. Dubia.Classis XIX.—*Metalla*.

Ord. 1. Dura. Ord. 2. Flexilia. Ord. 3. Fixa.

WERNER'S MINERAL SYSTEM IN 1789.

CLASS I.—EARTHY and STONY SUBSTANCES.

a. FLINTY MINERALS (Kiesel-Arten.)

- | | |
|--------------------------------------|------------------|
| 1. Diamond | c. Rose quartz |
| 2. Chrysoberyl | d. Common quartz |
| 3. Zircon | e. Prase |
| 4. Hyacinth | 15. Hornstone |
| 5. Chryrosolite | 16. Flint |
| 6. Garnet, <i>without subspecies</i> | 17. Calcedony |
| 7. Ruby | a. common |
| 8. Sapphire | b. carnelian |
| 9. Topaz | 18. Woodstone |
| 10. Emerald | 19. Heliotrope |
| 11. Beryl | 20. Chrysoprase |
| common | 21. Flinty-slate |
| schorlous | a. Common |
| 12. Schorl | b. Lydian-stone |
| black | 22. Obsidian |
| electrical | 23. Cat's-eye |
| 13. Thumerstone | 24. Prehnite |
| 14. Quartz | 25. Zeolite |
| a. Amethyst | 26. Azure-stone |
| b. Rock-crystal | |

b. CLAYEY MINERALS.

- | | |
|---------------------|---------------------|
| 27. Pure clay | (1.) Potters' clay |
| 28. Porcelain earth | (2.) Indurated clay |
| 29. Common clay | (3.) Slate-clay |
| | 30. Jasper |

- | | |
|-----------------------|-------------------------------|
| 30. Jasper | 43. Mica |
| (1.) Egyptian jasper | 44. Chlorite |
| (2.) Striped jasper | <i>a.</i> Chlorite-earth |
| (3.) Porcelain jasper | <i>b.</i> Common chlorite |
| (4.) Common jasper | <i>c.</i> Chlorite-slate |
| 31. Opal | 45. Chalkolite |
| 32. Pitchstone | 46. Hornblende |
| 33. Adamantine spar | <i>a.</i> Common |
| 34. Felspar | <i>b.</i> Hornblende-slate |
| (1.) Common | <i>c.</i> Labrador hornblende |
| (2.) Labrador | <i>d.</i> Basaltic |
| (3.) Moonstone | 47. Wacke |
| 35. Clay-slate | 48. Basalt |
| 36. Bituminous shale | 49. Lava |
| 37. Alum-earth | 50. Pumice |
| 38. Alum-slate | 51. Green earth |
| <i>a.</i> Common | 52. Lithomarge |
| <i>b.</i> Shining | <i>a.</i> Friable |
| 39. Alum-stone | <i>b.</i> Indurated |
| 40. Black chalk | 53. Mountain-soap |
| 41. Whet-slate | 54. Yellow earth. |
| 42. Tripoli | |

c. TALCKY MINERALS.

- | | |
|---------------------|---------------------------|
| 55. Steatite | 62. Asbestus |
| 56. Nephrite | <i>a.</i> Mountain-cork |
| 57. Fuller's earth | <i>b.</i> Amianthus |
| 58. Meerschäum | <i>c.</i> Common asbestus |
| 59. Bole | <i>d.</i> Mountain-wood |
| 60. Serpentine | 63. Kyanite |
| 61. Talc | 64. Actynolite |
| <i>a.</i> Earthy | <i>a.</i> Common |
| <i>b.</i> Common | <i>b.</i> Glassy |
| <i>c.</i> Indurated | <i>c.</i> Asbestous |
| | <i>d.</i> CALCAREOUS |

d. CALCAREOUS MINERALS.

A. Carbonates.

- 65. Rock-milk
- 66. Chalk
- 67. Limestone
 - a. Compact
 - α . Common
 - β . Roestone
 - b. Foliated
 - α . Granular
 - β . Calcareous-spar
 - c. Radiated and Fibrous
Limestone or Calc-sinter
 - d. Peastone
- 68. Slate Spar
- 69. Brown Spar
- 70. Stinkstone
- 71. Marl
 - Earthy
 - Indurated
- 72. Bituminous Marl-Slate
- B. Phosphates.
- 73. Apatite

C. Fluates.

- 74. Fluor
 - a. Fluor-Earth
 - b. Compact Fluor
 - c. Fluor-Spar
- D. Sulphates.

75. Gypsum

- a. Earthy
- b. Compact
- c. Foliated
- d. Fibrous

76. Selenite

E. Borate.

77. Boracite

F. Barytic Minerals.

78. Witherite

79. Heavy-spar

- a. Earthy Heavy-spar
- b. Compact Heavy-spar
- c. Foliated Heavy-spar
- d. Lamellar Heavy-spar
- c. Bolognese Spar

CLASS II.—SALINE MINERALS.

- a. Alkaline Salts
- 80. Native Mineral Alkali
 - b. Nitrous Salts.
- 81. Native Saltpetre
 - c. Muriatic Salts.
- 82. Common Rock-Salt
 - Common
 - Fibrous

83. Native Sal-Ammoniac

d. Vitriolic Salts.

- 84. Native Vitriol
- 85. Hair-Salt
- 86. Rock-Butter
- 87. Native Bitter-Salt.

CLASS III.—INFLAMMABLE MINERALS.

- | | |
|---------------------------------|-----------------------|
| <i>a. Sulphureous Minerals.</i> | 92. Stone coal |
| 88. Native sulphur | <i>a. Glance-coal</i> |
| <i>a. Common</i> | <i>b. Pitch-coal</i> |
| <i>b. Volcanic</i> | <i>c. Slate-coal</i> |
| <i>b. Bituminous Minerals.</i> | <i>c. Graphite.</i> |
| 89. Naphtha | 93. Graphite |
| 90. Mineral oil | <i>d. Amber.</i> |
| 91. Bituminous wood | 94. Amber |
| <i>a. Common</i> | <i>a. White</i> |
| <i>b. Earthy</i> | <i>b. Yellow</i> |
| | 95. Honeystone |

CLASS IV.—METALLIFEROUS MINERALS.

- | | |
|----------------------------|----------------------------|
| 1. <i>Platina.</i> | 105. Nagiaker silver |
| 96. Native platina | 106. Arsenical silver. |
| 2. <i>Gold.</i> | 107. Horn-ore |
| 97. Native Gold | 108. Black silver-ore |
| <i>a. Gold-yellow</i> | 109. Vitreous silver-ore |
| <i>b. Brass-yellow</i> | 110. Brittle silver-ore |
| <i>c. Greyish-yellow</i> | 111. Red silver-ore |
| 98. Nagiaker ore | <i>a. Dark</i> |
| 3. <i>Mercury.</i> | <i>b. Bright</i> |
| 99. Native Mercury | 112. White silver-ore |
| 100. Native amalgam | 5. <i>Copper.</i> |
| 101. Mercurial horn-ore | 113. Native copper |
| 102. Mercurial hepatic ore | 114. Copper-glance |
| <i>a. Compact</i> | <i>a. Compact</i> |
| <i>b. Slaty</i> | <i>b. Foliated</i> |
| 103. Cinnabar | 115. Variegated copper-ore |
| <i>a. Dark red</i> | 116. Copper-pyrites |
| <i>b. Bright red</i> | 117. White copper-ore |
| 4. <i>Silver.</i> | 118. Grey copper-ore |
| 104. Native silver | 119. Black copper |
| | 120. Red |

120. Red copper-ore
 - a. Compact
 - b. Foliated
 - c. Capillary
121. Tile-ore
 - a. Earthy
 - b. Compact
122. Azure copper
 - a. Earthy
 - b. Radiated
123. Malachite
 - a. Fibrous
 - b. Compact
124. Copper-green
125. Iron-shot copper-green
 - a. Earthy
 - b. Slaggy
126. Olivine ore
 6. Iron.
127. Native iron
128. Iron-pyrites
 - a. Common
 - b. Radiated
 - c. Liver
 - d. Capillary
129. Magnetical pyrites
130. Magnetical iron-ore
 1. Common
 2. Iron-sand
131. Iron-glance
 - a. Common
 - b. Iron-mica
132. Red ironstone
 - a. Red iron-froth
 - b. Compact red ironstone
- c. Red hematite
 - d. Red iron-ochre
133. Brown ironstone
 - a. Brown iron-froth
 - b. Compact br. ironstone
 - c. Brown hematite
 - d. Brown iron-ochre
134. Sparry ironstone
135. Clay-ironstone
 - a. Columnar
 - b. Lenticular
 - c. Reddle
 - d. Common
 - e. Reniform
 - f. Pea-ore
136. Bog iron-ore
 - a. Morass
 - b. Marsh
 - c. Meadow
137. Blue iron-earth
138. Green iron-earth
139. Emery
140. Pitchblende
 7. Lead.
141. Lead-glance
 - a. Common
 - b. Compact
142. Blue lead-ore
143. Brown lead-ore
144. White lead-ore
145. Green lead-ore
146. Black lead-ore
147. Red lead-ore
148. Yellow lead-ore
149. Yellow lead-earth
 - a. Friable

- a. Friable
 - b. Indurated
- 150. Grey lead-earth
 - a. Friable
 - b. Indurated
- 151. Red lead-earth
 - a. Friable
 - b. Indurated
- 8. *Tin*.
- 152. Tin-pyrites
- 153. Tinstone
- 154. Cornish tin-ore
 - 9. *Bismuth*.
- 155. Native bismuth
- 156. Bismuth-glance
- 157. Bismuth-ochre
 - 10. *Zinc*.
- 158. Blende
 - a. Yellow
 - b. Brown
 - c. Black
- 159. Calamine
 - 11. *Antimony*.
- 160. Native antimony
- 161. Grey antimony-ore
 - a. Compact
 - b. Foliated
 - c. Radiated
 - d. Plumose
- 162. Red antimony-ore
- 163. White antimony-ore
- 12. *Manganese*.
- 164. Grey Manganese-ore
- 165. Black Manganese-ore
- 166. Red Manganese-ore
 - 13. *Nickel*.
- 167. Copper-nickel
- 168. Nickel-ochre
 - 14. *Cobalt*.
- 169. Grey cobalt-ore
- 170. Glance cobalt
- 171. Black earthy cobalt
 - a. Loose
 - b. Indurated
- 172. Brown earthy cobalt
- 173. Yellow earthy cobalt
- 174. Red cobalt
 - a. Cobalt-bloom
 - b. Cobalt-crust
- 15. *Arsenic*.
- 175. Native arsenic
- 176. Arsenical pyrites
 - a. Common
 - b. Argentiferous
- 177. Orpiment
 - a. Yellow
 - b. Red
- 16. *Molybdena*.
- 178. Molybdena
 - 17. *Scheelium*.
- 179. Tungsten
- 180. Wolfram

KIRWAN'S MINERAL SYSTEM IN 1794.

I. EARTHY SUBSTANCES.

I. *Calcareous Genus.*

- | | |
|--------------------------|---------------------------|
| 1. Native Lime | 14. Marlites |
| 2. Carbonat of Lime | Argilliferous |
| 3. Agaric Mineral | Siliciferous |
| 4. Chalk | Bituminous |
| 5. Ganil | 15. Pyritaceous Limestone |
| 6. Testaceous Tufa | 16. Argentine |
| 7. Limestone, Compact | 17. Sidero-calcite |
| Splintery fracture | 18. Ferri-calcite |
| Conchoidal fracture | 19. Dolomite |
| Earthy fracture | 20. Elastic Marble |
| Slaty fracture | 21. Gypsum |
| Foliated and granular | Farinaceous |
| Sparry . | Compact |
| Arragon-spar | Fibrous or striated |
| Striated or fibrous | Foliated |
| 8. Swinestone | Specular |
| 9. Oviform | 22. Fluor |
| 10. Baryto-calcite | Sandy |
| 11. Muri-calcite | Compact |
| 12. Argillo-calcite | Foliated or sparry |
| 13. Marl, semi-indurated | 23. Phosphorate |
| Indurated | 24. Tungsten |
| Siliciferous | Grey |
| | Brown |

2. *Barytic Genus.*

- | | |
|-------------------------------|---------------------|
| 1. Barolite, or Aerated Bary- | Baroselenite |
| tes | Foliated |
| 2. Baroselenite | Striated or Fibrous |
| Earthy | Acicular |
| Compact | 3. Liver-stone |

3. *Muriatic Genus.*

- | | |
|--------------------------|-----------------------|
| 1. Kiffekill | 11. Asbestus |
| 2. Martial Muriatic-spar | Ligniform |
| 3. Calci-muriate | 12. Amianthus |
| 4. Argillo-muriate | 13. Suber montanum |
| 5. Chlorite | 14. Amianthinite |
| Indurated | 15. Asbestinite |
| Slaty | 16. Asbestoid, Common |
| 6. Talcite | Metalliform |
| 7. Talc | 17. Actinolyte |
| Shistose | Lamellar |
| 8. Steatites, Common | Shorlaceous |
| Indurated | Glassy |
| Foliated | 18. Jade |
| 9. Potstone | 19. Boracite |
| 10. Serpentine | |

4. *Argillaceous Genus.*

- | | |
|----------------------|-----------------------|
| 1. Native Argil | 8. Lithomarga |
| 2. Porcelain Clay | Friable |
| 3. Potter's Clay | Indurated |
| 4. Indurated Clay | 9. Bole |
| 5. Shistose Clay | 10. Argillaceous Marl |
| 6. Shale, Bituminous | 11. Chalk |
| 7. Fuller's Earth | Red |

Chalk

- | | |
|-----------------|-------------------------|
| Chalk, yellow | 23. Labrador Hornblende |
| Black | 24. Schiller-spar |
| 13. Green Earth | 25. Shistose Hornblende |
| 14. Umber | 26. Wacken |
| 15. Tripoli | 27. Mullen |
| 16. Phospholite | 28. Kragg |
| 17. Lepidolite | 29. Trap |
| 18. Sappare | 30. Basalt |
| 19. Mica | 31. Calp |
| 20. Micarelle | 32. Argillite |
| 21. Hornblende | 33. Novaculite |
| 22. Basaltine | |

5. *Siliceous Genus.*

- | | |
|------------------------------|--|
| 1. Mountain Crystal & Quartz | 16. Tourmaline |
| 2. Amethyst | 17. Thumerstone |
| 3. Emerald | 18. Prehnite |
| 4. Beryl | 19. <i>Ædilite</i> , or Siliceous Zeo-
lite |
| 5. Prasium | 20. Zeolite |
| 6. Oriental Ruby | 21. <i>Stauroilite</i> , or Cross-stone
of St Andreasberg in the
Hartz |
| Topaz | |
| Sapphire | |
| 7. Spinel and Balas Rubies | 22. Lapis Lazuli |
| 8. Occidental Ruby | 23. Chrysoprasium |
| Topaz or Brazilian | 24. Vesuvian, or White Garnet
of Vesuvius |
| Sapphire | |
| 9. Hyacinth | 25. Shorlite |
| 10. Garnet | 26. Rubellite |
| Oriental | 27. Opal |
| Common | 28. Semi-opal |
| Amorphous | 29. Pitchstone |
| 11. Chrysoberyl | 30. Hydrophane |
| 12. Chrysolite | 31. Hyalite, Muller's Glass of
the Germans |
| 13. Oliven | |
| 14. Obsidian | |
| 15. Shorl | |
| Vol. I. | 32. Calcedony |

- | | |
|-------------------------|-----------------------------|
| 32. Calcedony | 43. Porcellanite |
| Common | 44. Heliotropium |
| Carnelian | 45. Woodstone |
| 33. Cat's-Eye | 46. Elastic Quartz |
| 34. Flint | 47. Felspar |
| 35. Hornstone | Common |
| 36. Schistose Hornstone | Moonstone |
| 37. Siliceous Shistus | Continuous |
| 38. Basanite | 48. Labrador Stone |
| 39. Hornslate | 49. Petrilite |
| 40. Jasper | 50. Argentine Felspar |
| Common | 51. Red-stone of Rawenstein |
| Striped | 52. Siliceous Spar |
| 41. Egyptian Pebble | 53. Agates |
| 42. Sinople | |

6. *Strontian Genus.*

1. Strontianite.

7. *Jargon Genus.*

1. Jargon or Zircon.

8. *Sydnecia Genus,*

9. *Adamantine Genus.*

1. Adamantine Spar.

II. SALINE SUBSTANCES.

- | | |
|----------------------------|-------------------|
| 1. Acids | 4. Epsom Salt |
| 2. Alkalies | 5. Alum |
| 3. Neutral Salts | 6. Aluminous ores |
| Spec. 1. Tartar Vitriolate | Stony |
| 2. Glauber's Salt | Earthy |
| 3. Vitriolic Ammoniac | |

- | | |
|----------------------------------|-----------------------|
| 1st Family, Slaty | 16. Muriated Tartarin |
| 2d, Compact | 17. Common Salt |
| 3d, Ligneous | Var. 1. Lamellar |
| 7. Vitriol of Iron | 2. Fibrous |
| 8. ——— of Copper | 18. Sal Ammoniac |
| 9. ——— of Zinc | 19. Muriated Barytes |
| 10. Mixed Iron, Copper, and Zinc | 20. ——— Lime |
| 11. Nitre | 21. ——— Magnesia |
| 12. Nitrated Soda | 22. ——— Argil |
| 13. Nitrous Ammoniac | 23. ——— Iron |
| 14. Nitrated Lime | 24. ——— Copper |
| 15. Nitrated Magnesia | 25. ——— Manganese |
| | 26. Tincal |

III. INFLAMMABLES.

Genus 1. *Inflammable Air*2. *Bituminous*

Species 1. Naphtha

2. Petrol

3. Mineral Tar

4. ——— Pitch

Var. 1. Cohesive

2. Maltha

3. Asphalt

5. Mineral Tallow

——— Cahoutchou

Genus 3. *Carbonaceous Substances*

Spec. 1. Native Carbon

2. Bituminous Carbon

Fam. 1. Cannel Coal

Var. 1. Compact

2. Slaty

Fam. 2. Impregnated
with Asphalt
and Maltha

Var. 1. From Whitehaven

2. — Wigan

3. — Swansea

4. — Leitrim

5. — Irvine

Fam. 3. Spurious Coal

Spec. 3. Antracolite

4. Plumbago

Genus 4. *Vegeto-Carbonated Substances*

Spec. 1. Carbonated Wood

Var. 1. Ligniform

2. Scaly or Earthy

3. Compact

- Spec. 2. Turf and Peat
 Genus 5. *Vegeto-Bituminous* .
 Spec. 1. Jet
 2. Amber
 Ambergris and Copal
 APPENDIX. Mellilite
 Genus 6. *Sulphur and its Ores*
 Spec. 1. Native Sulphur
 2. Hepatic Air
 3. Sulphur combined
 with Argil
 4. — mixed with Argil
 5. United with Calcareous Earth
6. United to Fixed Alkalies
 7. — to Metallic Substances
 8. Martial Pyrites
 Fam. 1. United to Iron in its metallic state
 Var. 1. Common Sulphur Pyrites
 2. Striated
 3. Capillary
 4. Magnetic
 Fam. 2. United to Calx of Iron
 Hepatic Pyrites

IV. METALLIC SUBSTANCES.

1. *Gold.*

Species 1. Native Gold Auriferous Ores

2. *Platina.*3. *Silver and its Ores.*

- Spec. 1. Native Silver
 Fam. 1. Pure
 2. Auriferous
 3. Cupriferous
 4. Antimoniated
 5. Arsenicated
- Spec. 2. Calciform
 3. Mineralised by Acids
 Fam. 1. Corneous
 2. Argillo-Muriated
- Spec. 4. Sulphurated Silver-ore
 5. Light Lamellar Silver-ore
 6. Sooty Silver-ore
- Spec. 7. Antimoniated Silver-ore
 8. Plumbiferous Antimoniated Silver-ore
 Fam. 1. Light Grey
 2. Dark Grey
 9. Cupriferous Sulphurated Silver-ore
 10. Red Silver-ore
 Fam. 1. Light Red
 2. Dark Red
 11. Scoriaceous
 12. Bismuthic
 13. Greenish and Reddish-black Silver-ore
 Subsidiary

4. *Copper*

4. *Copper and its Ores.*

Spec. 1. Native Copper

Var. 1. ———

2. Cement Copper

Spec. 2. Calciform Copper-ores

Tribe i. Blue

Var. 1. Mountain Blue

2. Striated

Tribe ii. Green

Fam. 1. Malachite

Var. 1. Fibrous

2. Compact

Fam. 2. Mountain Green

Tribe iii. Red

Fam. 1. Cochineal Red

Var. 1. Compact

2. Foliated

3. Fibrous

Fam. 2. Brick Red

Var. 1. Earthy

2. Indurated

Spec. 3. Mineralised by Sulphur

Fam. 1. Copper-Pyrites

2. Purple

3. Black

4. Vitreous

Var. 1. Compact

2. Foliated

Fam. 5. Grey

Spec. 4. Mineralised by Muriatic Acid

5. Mineralised by Arsenical Acid

Olive Copper-ore

Earthy Iron shot

Mountain Green

Glassy Iron shot

Mountain Green

6. Mineralised by Arsenic

White Copper

Various Cupriferous Compounds

5. *Iron and its Ores.*

Spec. 1. Native Iron

2. Mineralised by pure Air

Tribe i.

Fam. 1. Common Magnetic Ironstone

2. Fibrous

3. Magnetic Sand

Tribe ii.

Fam. 1. Specular Iron-ore

2. Brown Hæmatites. Tribe iv. Argillaceous Iron-ores

3. Compact Brown Ironstone

4. Brown scaly Ore

5. Brown Iron-ochre

6. Black Ironstone

Tribe iii.

Fam. 1. Red Hæmatites

2. Compact Red Ironstone

3. Red Ochre

4. Red scaly Iron-ore

Fam. 1. Upland Argillaceous

Var. 1.

- | | |
|---|--|
| Var. 1. Common Argil-
laceous Iron-
stone | Var. 2. Swampy
3. Morassy |
| 2. Columnar Iron-
ore | Spec. 3. Mineralised by Carbon
Plumbaginous |
| 3. Acinose | 4. Blue Martial Earth |
| 4. Nodular | 5. Blue Iron-ore of Vorau |
| 5. Pisiform | 6. Green Martial Earth |
| Fam. 2. Lowland Argilla-
ceous Iron-ore | 7. Mineralised by Sulphur |
| Siderite | 8. Mineralised by Arsenic |
| Sideritic Calx | 9. Mineralised by the Ar-
senical Acids |
| Var. 1. Lowland Ores | 10. Sparry Iron-ore |
| Meadow | 11. Emery |
| | 12. Tungstenic Iron-ore |

6. *Tin and its Ores.*

- | | |
|--------------------------|--------------------------|
| Spec. 1. Native Tin | Fam. 2. Fibrous, or Wood |
| 2. Mineralised by Oxygen | Tin-ore |
| Fam. 1. Common Tinstone | 3. Tin-Pyrites |

7. *Lead and its Ores.*

- | | |
|---|------------------------------------|
| Spec. 1. Native Lead | Spec. 6. Vitriolated |
| 2. Mineralised by Oxygen
and Fixed Air | 7. Yellow Molybdenated
Lead-ore |
| Fam. 1. White Lead-ore | 8. Red Lead-spar |
| 2. Earthy, Yellowish,
Greenish, &c. Lead-
ore | 9. Mineralised by Sulphur |
| 3. Earthy Red Lead-ore | Fam. 1. Common Galena |
| Spec. 2. Phosphorated Lead-ore | 2. Compact |
| 4. Arsenicated Lead-ore | 3. Blue Lead-ore |
| 5. Arsenico-phosphorated | 4. Black Lead-ore |
| | Brown Lead-ore of Werner |

8. *Mercury*

8. *Mercury and its Ores.*

- | | |
|---------------------------|---------------------------|
| Spec. 1. Native | 5. Mineralised by Sulphur |
| 2. Natural Amalgama | Fam. 1. Native Æthiops |
| 3. Mineralised by Oxygen | 2. Native Cinnabar |
| Fam. 1. Compact | Dark Red |
| 2. Slaty | Bright Red |
| 4. Corneous Mercurial Ore | 3. Greyish Black |

9. *Zinc and its Ores.*

- | | |
|-------------------|-----------------|
| Spec. 1. Calamine | Spec. 2. Blende |
| Fam. 1. Loose | Fam. 1. Yellow |
| 2. Compact | 2. Brown |
| 3. Striated | 3. Black |

10. *Antimony and its Ores.*

- | | |
|-----------------|--|
| Spec. 1. Native | Spec. 3. Sulphurated and Arsenicated Plumose |
| 2. Sulphurated | 4. Red Antimonial Ore |
| Fam. 1. Compact | 5. Muriated |
| 2. Foliated | Antimonial Ochre |
| 3. Striated | Supposed Phosphorated Antimony |

11. *Arsenic and its Ores.*

- | | |
|------------------------------|--------------------------------|
| Spec. 1. Native Arsenic | Spec. 4. Mineralised by Oxygen |
| 2. Do. Alloyed with Iron | Loose |
| 3. Do. with Sulphurated Iron | Indurated |
| | 5. Mineralised by Sulphur |
| | Fam. 1. Orpiment |
| | 2. Realgar. |

12. *Bismuth and its Ores.*

- | | |
|-------------------------|---------------------------|
| Spec. 1. Native Bismuth | 3. Mineralised by Sulphur |
| 2. Bismuth Ochre | |
| Earthy | |
| Crystallised | |

13. *Cobalt*

13. *Cobalt and its Ores.*

- | | |
|-------------------------------|-------------------------------|
| Spec. 1. Dull grey Cobalt-ore | Fam. 3. Yellow |
| 2. Bright white Cobalt-ore | Spec. 4. Red Cobalt-ore |
| 3. Mineralised by Oxygen | Fam. 1. Cobalt Germinations |
| Fam. 1. Black Cobalt-ore | 2. Cobaltic Incrustations |
| Loose | |
| Indurated | |
| 2. Brown | Green and Violet Cobalt-ores. |

14. *Nickel and its Ores.*

- | | |
|--|-----------------------------|
| Spec. 1. Native Nickel alloyed by Iron | Spec. 3. Arsenicated Nickel |
| 2. Nickel Ochre, and Vitriol, Loose | 4. Sulphurated Nickel |
| Indurated | |

15. *Manganese and its Ores.*

- | | |
|--------------------------|--|
| Spec. 1. Native | Spec. 3. Mineralised by Oxygen and fixed air |
| 2. Mineralised by Oxygen | |
| Fam. 1. Grey | Fam. 1. White |
| 2. Black | 2. Red |
| Earthy | 4. Vitriolated Manganese |
| Indurated | |

16. *Uranite and its Ores.*

- | | |
|-------------------------------|----------------------|
| Spec. 1. Mineralised by Acids | Spec. 2. Sulphurated |
| Fam. 1. Uranitic Ochre | |
| 2. Micaceous | |

17. *Tungstenite and its Ores.*

- | | |
|-----------------------|------------------|
| Spec. 1. Tungsten | Spec. 2. Wolfram |
| Fam. 1. White or Grey | |
| 2. Brown | |

18. *Molybdenite.*
Molybdena

19. *Sylvanite.*

20. *Menachanite.*

21. *Titanite.*
Calcareo Siliceous-ore.

MOHS'
MINERAL SYSTEM IN 1804.

CLASS I.—EARTHY MINERALS.

- | | |
|---------------------------------|-----------------------|
| 1. Diamond family | 15. Clay-slate family |
| 2. Zircon family | 16. Mica family |
| 3. Chrysoberyl family | 17. Trap family |
| 4. Augite family | 18. Lithomarge family |
| 5. Garnet family | 19. Bole family |
| 6. Spinel family | 20. Talc family |
| 7. Hardstone (Hartstein) family | 21. Actynolite family |
| 8. Schorl family | 22. Limestone family |
| 9. Quartz family | 23. Brown-spar family |
| 10. Opal family | 24. Marl family |
| 11. Obsidian family | 25. Apatite family |
| 12. Zeolite family | 26. Fluor family |
| 13. Felspar family | 27. Gypsum family |
| 14. Clay family | 28. Baryte family |
| | 29. Saltstone family |

CLASS. II.—SALINE MINERALS.

- | | |
|-------------------------|------------------------|
| 30. Family of carbonats | 32. Family of muriats |
| 31. Family of nitrats | 33. Family of sulphats |

CLASS III.—INFLAMMABLE MINERALS.

- | | |
|--------------------|---------------------|
| 34. Sulphur family | 36. Coal family |
| 35. Amber family | 37. Graphite family |

CLASS IV.

CLASS IV.—METALLIC MINERALS.

- | | |
|---------------------------|----------------------------|
| 38. Family, Native Gold | 49. Family, Iron-earth |
| 39. ——— Mercurial-ores | 50. ——— Manganese |
| 40. ——— Native Silver | 51. ——— Manakan |
| 41. ——— Silver-ores | 52. ——— •Lead-ore |
| 42. ——— Native Copper | 53. ——— Tinstone |
| 43. ——— of Copper-pyrites | 54. ——— Speiss-cobalt |
| 44. ——— Malachite | 55. ——— Cobalt-ochre |
| 45. ——— Copper-emerald | 56. ——— Earthy Cobalt-ores |
| 46. ——— Native Iron | 57. ——— Native Arsenic |
| 47. ——— Iron-pyrites | 58. ——— Antimony-ores |
| 48. ——— Ironstone | 59. ——— Uranium-ores |

APPENDIX.

262. Needle-ore

263. Chrome-ochre

BRONG-

BRONGNIART'S
MINERAL SYSTEM IN 1807.

Classe I.—*Les Oxigénés non Metalliques.*

L'oxigène combiné avec des bases non metalliques.

Ord. 1.—*Les Oxigénés non Acides.*

L'oxigène formant avec ces bases des corps non acides.

Generes, Air, Eau.

Ord. 2.—*Les Oxigénés non Acides.*

L'oxigène formant avec ces bases des corps acides.

Acides Sulphurique, Muriatique, Carbonique et Boracique.

Classe II.—*Les Sels non Metalliques.*

Une base non-metallique combinée avec un acide.

Ord. 1.—*Les Sels Alcalins.*

Une base alcaline avec un acide.

Ord. 2.—*Les Sels Terreux.*

Une base terreuse avec un acide.

Ord. 3.—*Les Sels Terreux.*

Une base terreuse combinée avec un acide.

Classe III.—*Les Pierres.*

Les terres combinées entr'elles, et quelquefois avec des principes accessoires alcalins, acides ou metalliques.

Ord. 1.—*Les Pierres dures.*

Seches et apres au toucher, une dureté assez considerable pour rayer le verre à vitre blanc.

Ord. 2.

Ord. 2.—Les Pierres Onctueuses.

Ne rayant point le verre, le plus tendre, douces, et même onctueuses au toucher.

Ord. 3.—Les Pierres Argilloïdes.

Aspect argilleux, odeur argilleuse, souvent douces au toucher.

Classe IV.—*Les Combustibles.*

Minéraux qui peuvent se combiner immédiatement avec l'oxygène.

Ord. 1.—Les Combustibles Composés.

Donnant de la fumée huileuse en brulant.

Ord. 2.—Les Combustibles Simples.

Ne donnant point de fumée huileuse dans leur combustion.

Classe V.—*Les Metaux.*

Minéraux ayant pour base une substance métallique.

Ord. 1.—Les Metaux Fragiles.

N'étant susceptibles de s'allonger ni sous le marteau ni sous le laminoir.

Ord. 2.—Les Metaux Ductiles.

Susceptibles de s'étendre sous le laminoir ou sous le marteau.

KARSTEN'S MINERAL SYSTEM IN 1808.

I. Class.—*Earthy Minerals.*

1. Order, Zirconia.
2. ——— Yttria.
3. ——— Glucina.
4. ——— Silica.
 - a. Silica and glucina.
 - b. Silica, with a very slight intermixture of other substances.
 - c. Silica with water.
 - d. Silica with water and alumina.
 - e. Silica, alumina, and lime, or an alkali.
 - f. Silica and magnesia.
 - g. Silica and lime.
 - h. Silica, lime, alumina, and gypsum.
5. Order, Alumina.
6. ——— Magnesia.
7. ——— Lime.
 - a. Lime with carbonic acid.
 - b. ——— phosphoric acid.
 - c. ——— fluoric acid.
 - d. ——— sulphuric acid.
 - e. ——— boracic acid.
8. Order, Strontian.
9. ——— Barytes.

II. Class.—

II. Class.—*Saline Minerals.*

1. Order, Carbonatés.
2. ——— Borates.
3. ——— Nitrates.
4. ——— Muriates.
5. ——— Sulphates.

III. Class.—*Inflammable Minerals.*IV. Class.—*Metallic Minerals.*

- | | |
|-------------------|---------------------|
| 1. Order, Platina | 13. Order, Antimony |
| 2. ——— Gold | 14. ——— Manganese |
| 3. ——— Mercury | 15. ——— Nickel |
| 4. ——— Silver | 16. ——— Cobalt |
| 5. ——— Copper | 17. ——— Arsenic |
| 6. ——— Iron | 18. ——— Uranium |
| 7. ——— Lead | 19. ——— Titanium |
| 8. ——— Molybdena | 20. ——— Scheel |
| 9. ——— Tin | 21. ——— Chrome |
| 10. ——— Zinc | 22. ——— Tantalum |
| 11. ——— Bismuth | 23. ——— Cerium |
| 12. ——— Tellurium | 24. ——— Columbium |

THOMSON'S

THOMSON'S
MINERAL SYSTEM IN 1810.

CLASS I.—STONES.

Order I.—*Earthy Stones.*

Families.—Diamond, Zircon, Chrysolite, Garnet, Ruby, Topaz, Schorl, Quartz, Pitchstone, Zeolite, Felspar, Clay-slate, Mica, Trap, Lithomarge, Soapstone, Talc, Actynolite, and Gadolinite.

Order 2.—*Saline Stones.*

i. Genus, Calcareous Salts.

- | | |
|-------------------------|------------------------|
| 1. Family of Carbonates | 4. Family of Sulphates |
| 2. Family of Phosphates | 5. Family of Borates |
| 3. Family of Fluates | |

ii. Genus, Barytic Salts.

Carbonate	Sulphate
-----------	----------

iii. Genus, Strontian Salts.

Carbonate	Sulphate
-----------	----------

iv. Genus, Magnesian Salts.

Sulphate	Borate
Carbonate	

v. Genus, Aluminous Salts.

CLASS II.—SALTS.

Genus i. Potash	Genus iii. Ammonia
ii. Soda	

CLASS III.—COMBUSTIBLES.

Genus i. Sulphur	Genus iii. Bitumen
ii. Resin	iv. Graphite

CLASS IV.

CLASS IV.—ORES.

- | | |
|--------------------------------------|--------------------------------------|
| Order i. <i>Gold</i> | Order xii. <i>Bismuth</i> |
| 1. Alloys | 1. Alloys. 2. Sulphurets. 3. Oxides |
| Order ii. <i>Platinum</i> | Order xiii. <i>Antimony</i> |
| 1. Alloys | 1. Alloys. 2. Sulphurets. 3. Oxides. |
| Order iii. <i>Iridium</i> | 4. Salts |
| 1. Alloys | Order xiv. <i>Arsenic</i> |
| Order iv. <i>Silver</i> | 1. Alloys. 2. Sulphurets. 3. Oxides. |
| 1. Alloys. 2. Sulphurets. 3. Oxides. | 4. Salts |
| 4. Salts | Order xv. <i>Cobalt</i> |
| Order v. <i>Mercury</i> | 1. Alloys. 2. Oxides |
| 1. Alloys. 2. Sulphurets. 3. Salts | 3. Salts |
| Order vi. <i>Copper</i> | Order xvi. <i>Manganese</i> |
| 1. Alloys. 2. Sulphurets. 3. Oxides. | 1. Oxides. 2. Salts |
| 4. Salts | Order xvii. <i>Chromium</i> |
| Order vii. <i>Iron</i> | 1. Alloys. 2. Oxides. |
| 1. Alloys. 2. Sulphurets. 3. Oxides. | 3. Salts |
| 4. Salts | Order xviii. <i>Uranium</i> |
| Order viii. <i>Nickel</i> | 1. Oxides |
| 1. Alloys. 2. Oxides | Order xix. <i>Molybdenum</i> |
| Order ix. <i>Tin</i> | 1. Sulphurets |
| 1. Sulphurets. 2. Oxides | Order xx. <i>Tungsten</i> |
| Order x. <i>Lead</i> | 1. Salts |
| 1. Sulphurets. 2. Oxides. 3. Salts | Order xxi. <i>Titanium</i> |
| Order xi. <i>Zinc</i> | 1. Oxides |
| 1. Sulphurets. 2. Oxides. 3. Salts | Order xxii. <i>Columbium</i> |
| | 1. Oxides |
| | Order xxiii. <i>Cerium</i> |
| | 1. Oxides. |

MURRAY'S
MINERAL SYSTEM IN 1812.

I. Saline Minerals.

- | | |
|---|--|
| 1. Native Salts, with a base,
of Ammonia | 3. Native Salts, with a base of
Soda. |
| 2. Native Salts, with a base
of Potash | |

II. Earthy Minerals.

- | | |
|-------------------------|----------------------|
| 1. Barytic Fossils | 6. Glucine Fossils |
| 2. Strontitic Fossils | 7. Siliceous Fossils |
| 3. Calcareous Fossils | 8. Zircon Fossils |
| 4. Magnesian Fossils | 9. Gadolinite. |
| 5. Argillaceous Fossils | |

III. Metallic Minerals.

- | | |
|--------------------|---------------------|
| 1. Native Gold | 13. Ores of Arsenic |
| 2. Native Platina | 14. ——— Bismuth |
| 3. Ores of Silver | 15. ——— Antimony |
| 4. ——— Quicksilver | 16. ——— Tellurium |
| 5. ——— Copper | 17. ——— Chrome |
| 6. ——— Iron | 18. ——— Molybdena |
| 7. ——— Lead | 19. ——— Tungsten |
| 8. ——— Tin | 20. ——— Titanium |
| 9. ——— Zinc | 21. ——— Uranium |
| 10. ——— Nickel | 22. ——— Tantalum |
| 11. ——— Cobalt | 23. ——— Cerium. |
| 12. ——— Manganese | |

MURRAY'S MINERAL SYSTEM IN 1812.

IV. *Inflammable Minerals.*

1. Native Sulphur.
2. Carbonaceous Minerals.
3. Inflammable Minerals, in which Hydrogen predominates.

HAUSMANN'S

HAUSMANN'S
MINERAL SYSTEM IN 1813.

CLASS I.—COMBUSTIBLES.

1. Order. INFLAMMABLES.

Non-Metallic Combustibles,

1. Sub-Order,—*Simple*,—Ex. *Diamond*, &c.2. Sub-Order,—*Compound*.Combinations of two or more non-Metallic Combustibles,
—Ex. *Graphite*, &c.

2. Order. METALS.

Native Metals and Alloys.—Ex. *Native Silver* and *Antimonial Silver*.

3. Order. ORES.

Combinations of Metals and Sulphur.—Ex. *Copper-Pyrites*.

CLASS 1I.—INCOMBUSTIBLES.

Oxidised Minerals, and Combinations of these.

1. Order. OXIDES.

1. Sub-Order. *Metallic Oxides.* Oxidised Metals, either simple, or in combination with each other, and sometimes also combined with earths or with water.—Ex. *Magnetic Ironstone*, and *Brown Ironstone*.

2. Sub-Order. *Earths*, variously combined with each other, and with metallic oxides and water.

1. Series. Simple, *Quartz*.

Indeterminate combinations of earths with each other, or with other matters.

2. Series. Compound, *Opal*.

Determinate combinations of earths with each other, or with other substances.

2. Order. OXYDOIDS.

Combinations of combustible bodies with oxygen, which possess neither the properties of bases nor of acids.
—Ex. *Water*.

3. Order. ACIDS.

4. Order. SALTS.

Combinations of Bases with Acids.

1. Sub-Order. *Earthy*.

With Earthy Bases,

1. Series. Aluminous Salts.

2. ——— Magnesian Salts.

2. Sub-

2. Sub-Order. *Alkaline.*

With Alkaline Bases.

1. Series. Salts of Soda
2. — Salts of Potash
3. — Salts of Ammonia
4. — Salts of Lime
5. — Salts of Strontian
6. — Salts of Barytes

3. Sub-Order. *Metallic.*

With Metallic Oxide Bases.

1. Series. Salts of Silver
2. — Salts of Mercury
3. — Salts of Copper
4. — Salts of Iron
5. — Salts of Manganese
6. — Salts of Lead
7. — Salts of Zinc
8. — Salts of Cobalt
9. — Salts of Nickel

AIKEN'S
MINERAL SYSTEM IN 1815.

Class I.—*Non-Metallic Combustible Substances.*

1. Combustible with flame. Mineral Oil,
2. Combustible without flame. Graphite.

Class II.—*Native Metals, and Metalliferous Minerals.*

Order I.—Volatilisable, wholly or in part, by the blowpipe on charcoal, into a vapour, which condenses in a pulverulent form on a piece of charcoal held over it,

1. Entirely, or almost entirely volatilisable.
 Lustre metallic. Native Arsenic.
 Lustre non-metallic. Cinnabar.
2. Partly volatilisable; the residue affording metallic grains with borax, on charcoal.
 Lustre metallic. Silver-white Cobalt-ore.
 Lustre non-metallic. Red Silver-ore.
3. Partly volatilisable; the residue not reducible to the metallic state.
 Lustre metallic, Common Iron-pyrites.
 Lustre non-metallic. Red Cobalt-ochre.

Order II.

Order II.—Fixed ; not volatilisable except at a white heat.

1. Assume or preserve the metallic form, after roasting on charcoal while any thing is dissipated, and subsequent fusion with borax.

Lustre metallic. Native Copper.

Lustre non-metallic. Malachite.

2. Not reducible to the metallic state before the blow-pipe on charcoal, either with or without borax.

Magnetic after roasting. Common Pyrites.

Not magnetic after roasting. Blende.

Class III.—*Earthy Minerals.*

Order I.—Soluble with effervescence, either wholly, or in considerable proportion, in cold and moderately dilute muriatic acid ; yield to the knife.

1. Effervesce vigorously. Marl.
2. Effervesce very feebly in cold, but more vigorously in warm, muriatic acid. Carbonate of Magnesia.

Order II.—Fusible before the Blowpipe.

1. Hardness equal or superior to that of quartz. Garnet.
2. Hardness superior to that of common window-glass ; generally yield in some degree to the knife. Felspar.
3. Yield to the knife ; and sometimes feebly scratch glass. Tremolite.
4. Yield easily to the knife, and sometimes to the nail. Heavy-spar.
5. Very soft ; yield to the nail. Gypsum.

Order III.

Order III.—Fused before the Blowpipe.

1. Hardness equal or superior to that of quartz. Flint.
2. Scratch glass ; sometimes yield to the knife. Opal.
3. Yield to the knife. Serpentine.
4. Yield to the nail, Mountain-cork.

Class IV.—*Saline Minerals.*

Soluble in Water ; Sapid,

Order I.—Afford a precipitate with carbonated alkali. Blue
Vitriol.

Order II.—Do not afford a precipitate with carbonated alkali.
Natron.

HAUY's

HAUY'S
MINERAL SYSTEM IN 1813.

PREMIERE CLASSE.

SUBSTANCES ACIDIFERES.

PREMIERE ORDRE.

Substances acidifères libres.

1. I. Acide sulfurique 2. II. Acide boracique

SECOND ORDRE.

Substances acidifères terreuse.

† A BASE SIMPLE.

1. Genre.—*Chaux.*

- | | |
|---|--------------------------------------|
| 3. 1. Chaux carbonatée | 5. 3. Chaux phosphatée |
| i. Chaux carb. <i>ferrifère</i> | Chaux phosphatée |
| ii. Chaux carb. <i>manganèsifère rose</i> | <i>quarzifère</i> |
| iii. Chaux carb. <i>ferro-manganèsifère</i> | 6. 4. Chaux fluatée |
| iv. Chaux carb. <i>quarzifère</i> | Chaux fl. <i>aluminifère</i> |
| v. Chaux carb. <i>magnèsifère</i> | 7. 5. Chaux sulfatée |
| vi. Chaux carb. <i>nacrée</i> | Chaux sul. <i>calcarifère</i> |
| vii. Chaux carb. <i>fétide</i> | 8. 6. Chaux anhydro-sulphatée |
| viii. Chaux carb. <i>bituminefère</i> | i. Chaux an.-sul. <i>murietifère</i> |
| 4. 2. Arragonite | ii. Chaux an.-sul. <i>quarzifère</i> |
| | iii. Chaux an.-sul. <i>épigène</i> |
| | 9. 7. Chaux nitratée |
| | 10. 8. Chaux arseniatée |

II. Genre.

II. Genre.—*Baryte*.

11. 1. Baryte sulfatée 12. 2. Baryte carbonatée
 Baryte sulfatée *fétide*

III. Genre.—*Strontiane*.

13. 1. Strontiane sulfatée 14. 2. Strontiane carbonatée
 Strontiane sul. *calcarei-*
 fère

IV. Genre.—*Magnésie*.

15. 1. Magnésie sulphatée 16. 2. Magnésie boratée
 i. Magnésie sul. *ferrifère* Magnésie bor. *calcarei-*
 ii. Magnésie sul. *cobalti-* *fère*
 fère 17. 3. Magnésie carbonatée
 Magnésie carb. *silicifère*

†† A BASE DOUBLE.

V. Genre.—*Chaux et Silice*.

18. Chaux boratée siliceuse.

VI. Genre.—*Silice et Alumine*.

19. Silice fluatée alumineuse ou Topaze.

TROISIEME ORDRE.

*Substances acidifères alkales.*1. Genre.—*Potasse*.

20. Potasse nitratée

II. Genre.—*Soude*.

21. 1. Soude sulfatée 23. 3. Soude boratée
 22. 2. Soude muriatée 24. 4. Soude carbonatée

III. Genre.—*Ammoniaque*.

25. 1. Ammoniaque sulfatée 26. 2. Ammoniaque muriatée

QUATRIEME ORDRE.

*Substances acidifères alkalo-terreuses.*Genre unique.—*Alumine*.

27. 1. Alumine sulfatée alcaline 28. 2. Alumine fluatée alcaline

Appendice.—*Glauberite*.

SECONDE CLASSE.

SUBSTANCES TERREUSES.

- | | |
|----------------------------------|------------------------------|
| 29. 1. Quarz | 47. 19. Yenite |
| i. Quarz- <i>hyalin</i> | 48. 20. Staurotide |
| ii. Quarz- <i>agathe</i> | 49. 21. Epidote |
| iii. Quarz- <i>résinite</i> | Epidote <i>manganesifère</i> |
| iv. Quarz- <i>jaspe</i> | 50. 22. Hypersthène |
| v. Quarz- <i>pseudomor-</i> | 51. 23. Wernerite |
| <i>phique</i> | 52. 24. Paranthine |
| 30. 2. Zircon | 53. 25. Diallage |
| 31. 3. Corindon | 54. 26. Gadolinite |
| i. Corindon- <i>hyalin</i> | 55. 27. Lazulite |
| ii. Corindon- <i>harmophane</i> | 56. 28. Mésotype |
| iii. Corindon- <i>granulaire</i> | Mésotype <i>altérée</i> |
| 32. 4. Cymophane | 57. 29. Stilbite |
| 33. 5. Spinelle | 58. 30. Laumonite |
| 34. 6. Emeraude | 59. 31. Prehnite |
| 35. 7. Euclase | 60. 32. Chabasie |
| 36. 8. Grenat | 61. 33. Analcime |
| Grenat <i>ferrifère</i> | Analcime <i>cubo-octa-</i> |
| 37. 9. Amphigène | <i>èdre</i> |
| 38. 10. Idocrase | 62. 34. Népheline |
| 39. 11. Mėionite | 63. 35. Harmotome |
| 40. 12. Feld-spath | 64. 36. Péridot |
| i. Feld-spath <i>tenace</i> | Péridot <i>décomposé</i> |
| ii. Feld-spath <i>décomposé</i> | 65. 37. Mica |
| 41. 13. Apophyllite | 66. 38. Pinite |
| 42. 14. Triphane | 67. 39. Disthène |
| 43. 15. Axinite | 68. 40. Dipyre |
| 44. 16. Tourmaline | 69. 41. Asbeste |
| Tourmaline <i>apyre</i> | 70. 42. Talc |
| 45. 17. Amphibole | Talc <i>pseudomorphique</i> |
| 46. 18. Pyroxène | 71. 43. Macle |

TROISIEME CLASSE.

SUBSTANCES COMBUSTIBLES.

PREMIERE ORDRE.

Substances combustibles simples.

72. 1. Soufre

74. 3. Anthracite

73. 2. Diamant

SECOND ORDRE.

Substances combustibles composées.

75. 1. Graphite

78. 4. Jayet

76. 2. Bitume

79. 5. Succin

77. 3. Houille

80. 6. Mellite

QUATRIEME CLASSE.

SUBSTANCES METALLIQUES.

PREMIERE ORDRE.

Non oxydables immédiatement, si ce n'est à un feu très violent, et réductibles immédiatement.

I. Genre.—*Platine.*81. Platine natif *ferrifère*II. Genre.—*Or.*

82. Or natif.

III. Genre.—*Argent.*

83. 1. Argent natif

86. 4. Argent antimoniac sulfuré

84. 2. Argent antimonial

Argent antimonial,
*ferro-arsenifère*Argent antimoniac sulfuré
noir

85. 3. Argent sulfuré

87. 5. Argent carbonaté

88. 6. Argent muriaté

SECOND ORDRE.

*Oxydables et réductibles immédiatement.*Genre Unique.—*Mercure.*

- | | |
|------------------------|---|
| 89. 1. Mercure natif | 91. 3. Mercure sulfuré |
| 90. 2. Mercure argenté | Mercure sulfuré <i>bitu-</i>
<i>minifère</i> |
| | 92. 4. Mercure muriaté |

TROISIEME ORDRE.

Oxydables, mais non réductibles immédiatement.

SENSIBLEMENT DUCTILES.

I. Genre.—*Plomb.*

- | | |
|---|--|
| 93. 1. Plomb natif <i>volcanique</i> | 98. 6. Plomb carbonaté |
| 94. 2. Plomb sulfuré | i. Plomb carbonaté <i>noir</i> |
| i. Plomb sulfuré <i>antimo-</i>
<i>nifère</i> | ii. Plomb carbonaté <i>cu-</i>
<i>prifère</i> |
| ii. Plomb sulfuré <i>antimo-</i>
<i>nio-arsenifère</i> | 99. 7. Plomb phosphaté |
| 95. 3. Plomb oxydé rouge | i. Plomb phosphaté <i>ar-</i>
<i>senifère</i> |
| 96. 4. Plomb arsenié | ii. Plomb sulfuré <i>épigène</i> |
| 97. 5. Plomb chromaté | 100. 8. Plomb molybdaté |
| | 101. 9. Plomb sulfaté |

II. Genre.—*Nickel.*

- | | |
|---|----------------------|
| 102. 1. Nickel natif | 104. 3. Nickel oxydé |
| 103. 2. Nickel arsenical | |
| Nickel arsenical <i>ar-</i>
<i>gentifère</i> | |

III. Genre.—*Cuivre.*

- | | |
|--|---|
| 105. 1. Cuivre natif | 107. 3. Cuivre gris |
| 106. 2. Cuivre pyriteux | i. Cuivre gris <i>arsenifère</i> |
| Cuivre pyriteux <i>hé-</i>
<i>patique</i> | ii. Cuivre gris <i>antimoni-</i>
<i>fère</i> |
| | iii. Cuivre gris <i>platinifère</i> |
| | 108. 4. Cuivre |

- | | |
|-------------------------------|------------------------------------|
| 108. 4. Cuivre sulfuré | 112. 8. Cuivre carbonaté vert |
| Cuivre sulfuré <i>hépa-</i> | 113. 9. Cuivre arseniaté |
| <i>tique</i> | i. Cuivre arseniaté <i>altéré</i> |
| 109. 5. Cuivre oxydulé | ii. Cuivre arseniaté <i>ferri-</i> |
| Cuivre oxydulé <i>ar-</i> | <i>fère</i> |
| <i>senifère</i> | 114. 10. Cuivre diopase |
| 110. 6. Cuivre muriaté | 115. 11. Cuivre phosphaté |
| 111. 7. Cuivre carbonaté bleu | 116. 12. Cuivre sulfaté |
| Cuivre carbonaté vert | |
| <i>épigène</i> | |

IV, Genre.—*Fer.*

- | | |
|----------------------------------|-----------------------------------|
| 117. 1. Fer natif | 121. 5. Fer sulfuré |
| i. Fer natif <i>volcanique</i> | i. Fer oxydé <i>épigène</i> |
| ii. Acier natif <i>pseudo-</i> | ii. Fer sulfuré <i>ferrifère</i> |
| <i>volcanique</i> | iii. Fer sulfuré <i>aurifère</i> |
| iii. Fer natif <i>météorique</i> | iv. Fer sulfuré <i>titanifère</i> |
| 118. 2. Fer oxydulé | 122. 6. Fer oxydé |
| Fer oxydulé <i>titani-</i> | i. Fer oxydé noir <i>vitreux</i> |
| <i>fère</i> | ii. Fer oxydé <i>résinite</i> |
| 119. 3. Fer oligiste | iii. Fer oxydé <i>carbonaté</i> |
| 120. 4. Fer arsenical | |
| Fer arsenical <i>argen-</i> | |
| <i>tifère</i> | |

V. Genre.—*Etain.*

- | | |
|---------------------|-----------------------|
| 123. 1. Etain oxydé | 124. 2. Etain sulfuré |
|---------------------|-----------------------|

VI, Genre.—*Zinc.*

- | | |
|-------------------------------|----------------------|
| 125. 1. Zinc oxydé | 127. 3. Zinc sulfuré |
| 126. 2. Zinc carbonaté | 128. 4. Zinc sulfaté |
| Zinc carbonaté <i>pseudo-</i> | |
| <i>morphique</i> | |

NON DUCTILES.

VII. Genre.—*Bismuth.*

- | | |
|--|-----------------------|
| 129. 1. Bismuth natif | 131. 3. Bismuth oxydé |
| 130. 2. Bismuth sulfuré | |
| Bismuth sulfuré <i>plumbocuprifère</i> | |

VIII. Genre.—*Cobalt.*

- | | |
|---------------------------|---|
| 132. 1. Cobalt arsenical | 135. 4. Cobalt arseniaté |
| 133. 2. Cobalt gris | Cobalt arseniaté <i>terreux argentifère</i> |
| 134. 3. Cobalt oxydé noir | |

IX. Genre.—*Arsenic.*

- | | |
|-----------------------|------------------------------|
| 136. 1. Arsenic natif | 138. 3. Arsenic sulfuré |
| 137. 2. Arsenic oxydé | Arsenic sulfuré <i>rouge</i> |
| | Arsenic sulfuré <i>jaune</i> |

X. Genre.—*Manganese.*

- | | |
|---|--|
| 139. 1. Manganèse oxydé | 140. 2. Manganèse sulfuré |
| i. Manganèse oxydé <i>noirâtre barytifère</i> | 141. 3. Manganèse phosphaté <i>ferrifère</i> |
| ii. Manganèse oxydé <i>carbonaté</i> | |

XI. Genre.—*Antimoine.*

- | | |
|--|---|
| 142. 1. Antimoine natif | ii. Antimoine oxydé <i>épigène</i> |
| Antimoine natif <i>arsénifère</i> | iii. Antimoine oxydé sulfuré <i>épigène</i> |
| 143. 2. Antimoine sulfuré | |
| i. Antimoine sulfuré <i>arsénifère</i> | 144. 3. Antimoine oxydé |
| | 145. 4. Antimoine oxydé sulfuré |

XII. Genre.—*Urane.*

- | | |
|-----------------------|---------------------|
| 146. 1. Urane oxydulé | 147. 2. Urane oxydé |
|-----------------------|---------------------|

XIII. Genre.

XIII. Genre.—*Molybdène*.

148. Molybdène sulfuré.

XIV. Genre.—*Titane*.

149. 1. Titane oxydé 150. 2. Titane anatase
 i. Titane oxydé *chromi-* 151. 3. Titane siliceo-calcaire
 fère
 ii. Titane oxydé *ferrifère*

XV. Genre.—*Schéelin*.

152. 1. Schéelin ferruginé 153. 2. Schéelin calcaire

XVI. Genre.—*Tellure*.

154. Tellure natif
 i. Tellure natif *auro-ferrifère*
 ii. Tellure natif *auro-argentifère*
 iii. Tellure natif *auro-plombifère*

XVII. Genre.—*Tantale*.

155. Tantale oxydé
 i. Tantale oxydé *ferro-manganesifère*
 ii. Tantale oxydé *yttrifère*

XVIII. Genre.—*Cerium*.

156. Cerium oxydé *silicifère*

XIX. Genre.—*Chromc*.

WERNER'S MINERAL SYSTEM IN 1815.



CLASS I.—EARTHY FOSSILS.

1. DIAMOND GENUS.

1. Diamond.

2. ZIRCON GENUS.

Zircon Family.

2. Zircon

4. Cinnamon-stone.

3. Hyacinth

3. FLINT GENUS.

Augite Family.

5. Chrysoberyl

c. conchoidal

6. Chrysolite

d. common

7. Olivine

10. *Baikalite*

8. Coccoilite

11. *Sahlite*

9. Augite

12. *Diopside*

a. granular

13. *Fassaite.*

b. foliated

Garnet Family.

- | | |
|---------------------|------------------------------------|
| 14. Vesuvian | 20. <i>Colophonite</i> |
| 15. Grossulare | 21. Garnet |
| 16. Leucite | a. Precious |
| 17. <i>Pyrenite</i> | b. Common |
| 18. Melanite | 22. <i>Staurolite</i> or Grenatite |
| 19. Allochroite | 23. Pyrope |

Ruby Family.

- | | |
|----------------|------------------|
| 24. Automalite | 29. Corundum |
| 25. Ceylanite | 30. Diamond-spar |
| 26. Spinel | — |
| 27. Sapphire | 31. Topaz |
| 28. Emery | |

Beryl Family.

- | | |
|-------------|----------------------------|
| 32. Iolite | a. Precious beryl |
| 33. Euclase | b. Common |
| 34. Emerald | 36. <i>Schorlous</i> Beryl |
| 35. Beryl | 37. Tourmaline |

Pistacite Family.

- | | |
|---------------|-------------------|
| 38. Lievrite | 42. Anthophyllite |
| 39. Pistacite | a. Radiated |
| 40. Diaspore | b. Foliated |
| 41. Zoisite | 43. Axinite |

Quartz Family.

- | | |
|------------------|------------------|
| 44. Quartz | 45. Iron-flint |
| a. Amethyst | 46. Hornstone |
| α. Common | a. Splintery |
| β. Thick fibrous | b. Conchoidal |
| b. Rock crystal | c. Woodstone |
| c. Milk quartz | 47. Flinty-slate |
| d. Common quartz | a. Common |
| e. Prase | b. Lydian-stone |
| | 48. Flint |

- | | |
|-------------------|-------------------------|
| 48. Flint | a. Egyptian jasper |
| 49. Chalcedony | α. Red |
| a. Common | β. Brown |
| b. Carnelian | b. Striped jasper |
| α. Common | c. Porcelain jasper |
| β. Fibrous | d. Common jasper |
| 50. Hyalite | α. Conchoidal |
| 51. Opal | β. Earthy |
| a. Precious | e. Opal jasper |
| b. Common opal | f. Agate jasper |
| c. Semi-opal | 54. Heliotrope |
| d. Wood-opal | 55. Chrysoprase |
| 52. Menilite | 56. Plasma |
| a. Brown menilite | 57. Cat's-eye |
| b. Grey menilite | 58. <i>Faser Kiesel</i> |
| 53. Jasper | 59. Elaolite |

Pitchstone Family.

- | | |
|----------------|----------------|
| 60. Obsidian | 62. Pearlstone |
| 61. Pitchstone | 63. Pumice |

Zeolite Family.

- | | |
|------------------|----------------------------|
| 64. Prehnite | c. Radiated Zeolite |
| a. Fibrous | d. Foliated do. |
| b. Foliated | 67. Ichthyophthalm |
| 65. Natrolite | 68. Cubicite |
| 66. Zeolite | 69. Cross-stone or Crucite |
| a. Mealy Zeolite | 70. Laumonite |
| b. Fibrous do. | 71. Schmelzstein |

Azurestone Family.

- | | |
|----------------|---------------|
| 72. Azurestone | 74. Blue-spar |
| 73. Azurite | |

Felspar Family.

- | | |
|---------------------------|--------------------------|
| 75. Andalusite | <i>α.</i> Common |
| 76. Felspar | <i>β.</i> Variolite |
| <i>a.</i> Adularia | 77. Spodumene |
| <i>b.</i> Labrador | 78. Scapolite |
| <i>c.</i> Glassy | <i>a.</i> Red scapolite |
| <i>d.</i> Common felspar | <i>b.</i> Grey scapolite |
| <i>α.</i> Fresh | <i>α.</i> Radiated |
| <i>β.</i> Disintegrated | <i>β.</i> Foliated |
| <i>e.</i> Hollow spar | 79. Meionite |
| <i>f.</i> Compact felspar | 80. Nepheline |
| | 81. Ice-spar |

4. CLAY GENUS.

Clay Family.

- | | |
|---------------------------|-------------------------------|
| 82. Pure clay | <i>d.</i> Slate clay |
| 83. Porcelain earth | 85. Claystone |
| 84. Common clay | 86. Adhesive slate |
| <i>a.</i> Loam | 87. Polishing or polier slate |
| <i>b.</i> Potter's clay | 88. Tripoli |
| <i>α.</i> Earthy | 89. Floatstone |
| <i>β.</i> Slaty | 90. Alum-stone |
| <i>c.</i> Variegated clay | |

Clay-Slate Family.

- | | |
|----------------------|-------------------|
| 91. Alum-slate | 93. Drawing-slate |
| <i>a.</i> Common | 94. Whet-slate |
| <i>b.</i> Glossy | 95. Clay-slate |
| 29. Bituminous shale | |

Mica Family.

- | | |
|----------------|---------------|
| 96. Lepidolite | 98. Pinite |
| 97. Mica | 99. Potstone |
| | 100. Chlorite |

- | | |
|--------------------|----------------------|
| 100. Chlorite | c. Chlorite-slate |
| a. Chlorite earth | d. Foliated chlorite |
| b. Common chlorite | |

Trap Family.

- | | |
|---------------------|-----------------|
| 101. <i>Paulite</i> | 103. Basalt |
| 102. Hornblende | 104. Wacke |
| a. Common | 105. Clinkstone |
| b. Basaltic | 106. Iron-clay |
| c. Hornblende-slate | — |
| | • 107. Lava |

Lithomarge Family.

- | | |
|------------------|-------------------|
| 108. Green earth | 110. Rock-soap |
| 109. Lithomarge | 111. Umber |
| a. Friable | 112. Yellow earth |
| b. Indurated | |

5. TALC GENUS.

Soapstone Family.

- | | |
|-------------------------------------|---------------------|
| 113. Native magnesia, or talc-earth | 116. Fuller's-earth |
| 114. Meerschaum | 117. Steatite |
| 115. Bole | 118. Figurestone |

Talc Family.

- | | |
|--------------------|--------------------|
| 119. Nephrite | 122. Talc |
| a. Common nephrite | a. Earthy |
| b. Axe-stone | b. Common |
| 120. Serpentine | c. Indurated |
| a. Common | 123. Asbestos |
| b. Precious | a. Rock-cork |
| α. Conchoidal | b. Amianthus |
| β. Splintery | c. Common asbestos |
| 121. Schillerstone | d. Rock-wood |

Actynolite

Actynolite Family.

- | | |
|--------------------------------|---------------------|
| 124. Kyanite | 127. Tremolite |
| 125. Actynolite | <i>a.</i> Asbestous |
| <i>a.</i> Asbestous | <i>b.</i> Common |
| <i>b.</i> Common | <i>c.</i> Glassy |
| <i>c.</i> Glassy | 128. Sahlite |
| <i>d.</i> Granular | 129. Rhodizite |
| 126. Spreustein or Chaff-stone | |

6. CALCAREOUS GENUS.

- | | | |
|----------------------------------|----------------------------|--------------------------|
| <i>A. Carbonates.</i> | | 142. Marl |
| 130. Rock-milk | | <i>a.</i> Marl earth |
| 131. Chalk | | <i>b.</i> Indurated marl |
| 132. Limestone | 143. Bituminous marl-slate | |
| <i>a.</i> Compact | 144. Arragon | |
| <i>a.</i> Common | <i>a.</i> Common | |
| <i>β.</i> Roestone | <i>b.</i> Prismatic | |
| <i>b.</i> Foliated | | <i>B. Phosphates.</i> |
| <i>a.</i> Granular | 145. Apatite | |
| <i>β.</i> Calcareous-spar | 146. Asparagus stone | |
| <i>c.</i> Fibrous | | <i>C. Fluates.</i> |
| <i>a.</i> Common | 147. Fluor | |
| <i>β.</i> Calc-sinter | <i>a.</i> Compact | |
| <i>d.</i> Pea-stone | <i>b.</i> Fluor-spar | |
| 133. Calc-tuff | | <i>D. Sulphates.</i> |
| 134. Schaum-earth, or foam-earth | 148. Gypsum | |
| 135. Slate-spar | <i>a.</i> Spumous gypsum | |
| 136. Brown-spar | <i>b.</i> Earthy gypsum | |
| <i>a.</i> Foliated | <i>c.</i> Compact gypsum | |
| <i>b.</i> Fibrous | <i>d.</i> Foliated gypsum | |
| 137. Schaalstone | <i>e.</i> Fibrous gypsum | |
| 138. Dolomite | 149. Selenite | |
| 139. Rhomb-spar | | 150. Muriacite |
| 140. Anthracolite | | |
| 141. Stinkstone | | |

150. Muriacite

- | | |
|-----------------------------|--------------------|
| <i>a.</i> Anhydrite | <i>E. Borates.</i> |
| <i>b.</i> <i>Gekröstein</i> | 151. Datolite |
| <i>c.</i> Conchoidal Mur. | 152. Boracite |
| <i>d.</i> Fibrous Mur. | 153. Botryolite |
| <i>e.</i> Compact Mur. | |

7. BARYTE GENUS.

- | | |
|--------------------------------------|--|
| 154. Witherite | <i>e.</i> Straight lamellar heavy-spar |
| 155. Heavy-spar | <i>α.</i> Fresh |
| <i>a.</i> Earthy heavy-spar | <i>β.</i> Disintegrated |
| <i>b.</i> Compact heavy-spar | <i>f.</i> Columnar spar |
| <i>c.</i> Granular heavy-spar | <i>g.</i> Prismatic spar |
| <i>d.</i> Curved lamellar heavy-spar | <i>h.</i> Bolognese, or Bolognian spar |

8. STRONTIAN GENUS.

- | | |
|--------------------|---------------------|
| 156. Strontian | <i>a.</i> Fibrous |
| <i>a.</i> Compact | <i>b.</i> Radiated |
| <i>b.</i> Radiated | <i>c.</i> Lamellar |
| 157. Celestine | <i>d.</i> Prismatic |

9. HALLITE GENUS.

158. Cryolite.

CLASS II.—FOSSIL SALTS.

- | | |
|-----------------------------|---------------------------|
| 1. <i>Carbonates.</i> | β . Fibrous |
| 159. Natural Soda or natron | <i>b.</i> Lake-salt |
| | 162. Natural sal-ammoniac |
| 2. <i>Nitrates.</i> | |
| 160. Natural nitre | 4. <i>Sulphates.</i> |
| | 163. Natural vitriol |
| 3. <i>Muriates.</i> | 164. Hair-salt |
| 161. Natural rock-salt | 165. Rock-butler |
| <i>a.</i> Stone-salt | 166. Natural Epsom-salt |
| <i>a.</i> Foliated | 167. Natural Glauber-salt |
-

CLASS III.—INFLAMMABLE FOSSILS.

1. SULPHUR GENUS.

- | | |
|------------------------|----------------------|
| 168. Natural sulphur | β . Conchoidal |
| <i>a.</i> Crystallised | <i>c.</i> Mealy |
| <i>b.</i> Common | <i>d.</i> Volcanic |
| <i>a.</i> Earthy | |

2. BITUMINOUS GENUS.

- | | |
|----------------------------|-----------------------------|
| 169. Mineral or fossil oil | <i>b.</i> Earth coal |
| 170. Mineral pitch | <i>c.</i> Alum earth |
| <i>a.</i> Elastic | <i>d.</i> Paper coal |
| <i>b.</i> Earthy | <i>e.</i> Common brown coal |
| <i>c.</i> Slaggy | <i>f.</i> Moor coal |
| 171. Brown coal | 172. Black coal |
| <i>a.</i> Bituminous wood | |
| | <i>a.</i> Pitch |

- | | |
|-------------------------|-------------------------|
| <i>a.</i> Pitch coal | <i>d.</i> Cannel coal |
| <i>b.</i> Columnar coal | <i>e.</i> Foliated coal |
| <i>c.</i> Slate coal | <i>f.</i> Coarse coal |

3. GRAPHITE GENUS.

- | | |
|----------------------|-----------------------|
| 173. Glance-coal, | 174. Graphite |
| <i>a.</i> Conchoidal | <i>a.</i> Scaly |
| <i>b.</i> Slaty | <i>b.</i> Compact |
| | 175. Mineral charcoal |

4. RESIN GENUS.

- | | |
|-----------------|------------------|
| 176. Amber | <i>b.</i> Yellow |
| <i>a.</i> White | 177. Honey stone |

CLASS IV.—METALLIC FOSSILS.

1. PLATINA GENUS.

178. Native Platina.

2. GOLD GENUS.

- | | |
|-----------------------|--------------------------|
| 179. Native gold | <i>b.</i> Brass yellow |
| <i>a.</i> Gold yellow | <i>c.</i> Greyish yellow |

3. MERCURY GENUS.

- | | |
|--------------------------|---------------------|
| 180. Native mercury | <i>a.</i> Compact |
| 181. Natural amalgam | <i>b.</i> Slaty |
| <i>a.</i> Semi-fluid | 184. Cinnabar |
| <i>b.</i> Solid | <i>a.</i> Dark-red |
| 182. Mercurial horn-ore | <i>b.</i> Light-red |
| 183. Mercurial liver-ore | |

4. SILVER

4. SILVER GENUS.

- | | |
|--|----------------------------|
| 185. Native silver | 190. Silver-black |
| <i>a.</i> Common | 191. Silver-glance |
| <i>b.</i> Auriferous | 192. Brittle silver-glance |
| 186. Antimonial silver | 193. Red silver-ore |
| 187. Arsenical silver | <i>a.</i> Dark |
| 188. <i>Molybdæna-silver</i> | <i>b.</i> Light |
| 189. Corneous silver-ore, or
horn-ore | 194. White silver-ore |

5. COPPER GENUS.

- | | |
|--------------------------------|---------------------------------|
| 195. Native copper | 284. Azure copper-ore |
| 196. Copper-glance | <i>a.</i> Earthy |
| <i>a.</i> Compact | <i>b.</i> Indurated or radiated |
| <i>b.</i> Foliated | 205. <i>Velvet copper-ore</i> |
| 197. Variegated copper-
ore | 206. Malachite |
| 198. Copper-pyrites | <i>a.</i> Fibrous |
| 199. White copper-ore | <i>b.</i> Compact |
| 200. Grey copper-ore | 207. Copper-green |
| 201. Black copper-ore | 208. Ironshot copper-green |
| 202. Red copper-ore | <i>a.</i> Earth |
| <i>a.</i> Compact | <i>b.</i> Slaggy |
| <i>b.</i> Foliated | 209. Emerald copper-ore |
| <i>c.</i> Capillary | 210. Copper-mica |
| 203. Tile-ore | 211. Lenticular-ore |
| <i>a.</i> Earthy | 212. Oliven-ore |
| <i>b.</i> Indurated | 213. Muriat of copper |
| | 214. Phosphat of copper |

6. IRON GENUS.

- | | |
|----------------------------|---|
| 215. Native iron | <i>c.</i> Liver or hepatic py-
rites |
| 216. Iron-pyrites | <i>d.</i> Cock's-comb pyrites |
| <i>a.</i> Common pyrites | <i>e.</i> Cellular pyrites |
| <i>b.</i> Radiated pyrites | 217. Capillary |

- | | |
|-------------------------------|---------------------------------|
| 217. Capillary pyrites | 226. Black ironstone |
| 218. Magnetic pyrites | <i>a.</i> Compact |
| 219. Magnetic ironstone | <i>b.</i> Black hematite |
| <i>a.</i> Common | 227. Clay-ironstone |
| <i>b.</i> Iron-sand | <i>a.</i> Reddle |
| 220. <i>Chrome-ironstone</i> | <i>b.</i> Columnar clay-iron- |
| 221. <i>Menac ironstone</i> | stone |
| 222. Iron-glance | <i>c.</i> Lenticular clay-iron- |
| <i>a.</i> Common | stone |
| <i>α.</i> Compact | <i>d.</i> Jaspersy clay-iron- |
| <i>β.</i> Foliated | stone |
| <i>b.</i> Iron-mica | <i>e.</i> Common clay-iron- |
| 223. Red ironstone | stone |
| <i>a.</i> Red iron-froth | <i>f.</i> Reniform clay-iron- |
| <i>b.</i> Ochry red ironstone | stone |
| <i>c.</i> Compact | <i>g.</i> Pea-ore, or pisiform |
| <i>d.</i> Red hematite | ironstone |
| 224. Brown ironstone | 228. Bog iron-ore |
| <i>a.</i> Brown iron-froth | <i>a.</i> Morass-ore |
| <i>b.</i> Ochry brown iron- | <i>b.</i> Swamp-ore |
| stone | <i>c.</i> Meadow-ore |
| <i>c.</i> Compact | 229. Blue iron-earth |
| <i>d.</i> Brown hematite | 230. Pitchy iron-ore |
| 225. Sparry ironstone. | 231. Green iron-earth |
| | 232. Cube-ore |
| | 233. Gadolinite |

7. LEAD GENUS.

- | | |
|--------------------------------|--------------------------------|
| 234. Galena or Lead-glance | 239. Green lead-ore |
| <i>a.</i> Common | 240. Red lead-ore |
| <i>b.</i> <i>Disintegrated</i> | 241. Yellow lead-ore |
| <i>c.</i> Compact | 242. Lead-vitriol. |
| 235. Blue lead-ore | 243. Earthy lead-ore, or Lead- |
| 236. Brown lead-ore | earth. |
| 237. Black lead-ore | <i>a.</i> Coherent |
| 238. White lead-ore | <i>b.</i> Friable |

8. TIN GENUS.

- | | |
|------------------|----------------------|
| 244. Tin pyrites | 246. Cornish tin-ore |
| 245. Tinstone. | |

9. BISMUTH GENUS.

- | | |
|---------------------|-----------------------------------|
| 247. Native bismuth | 249. Bismuth-ochre |
| 248. Bismuth-glance | 250. <i>Arsenical bismuth-ore</i> |

10. ZINC GENUS.

- | | |
|---------------------|---------------------|
| 251. Blende | β . Fibrous |
| <i>a</i> . Yellow | γ . Radiated |
| <i>b</i> . Brown | <i>c</i> . Black |
| <i>a</i> . Foliated | 252. Calamine |

11. ANTIMONY GENUS.

- | | |
|------------------------|-------------------------|
| 253. Native antimony | 255. Black antimony-ore |
| 254. Grey antimony-ore | 256. Red antimony-ore |
| <i>a</i> . Compact | 257. White antimony-ore |
| <i>b</i> . Foliated | 258. Antimony-ochre |
| <i>c</i> . Radiated | |
| <i>d</i> . Plumose | |

12. SYLVAN GENUS.

- | | |
|--------------------|-----------------------|
| 259. Native sylvan | 261. White sylvan-ore |
| 260. Graphic-ore | 262. Nagyag-ore |

13. MANGANESE GENUS.

- | | |
|-------------------------|--------------------------------------|
| 263. Grey manganese-ore | 264. Black manganese-ore |
| <i>a</i> . Radiated | 265. <i>Piedmontese manganes-ore</i> |
| <i>b</i> . Foliated | 266. Red manganese-ore |
| <i>c</i> . Compact | 267. <i>Manganese-spar</i> |
| <i>d</i> . Earthy | |

14. NICKEL GENUS.

- | | |
|-------------------------------|-------------------|
| 268. Copper-nickel | 270. Nickel-ochre |
| 269. <i>Capillary-pyrites</i> | |

15. COBALT

15. COBALT GENUS.

Family of Speiss-Cobalt.

- | | |
|-----------------------|--------------------|
| 271. White cobalt-ore | 273. Glance-cobalt |
| 272. Grey cobalt-ore | |

Family of Cobalt-Ochre.

- | | |
|-------------------------|--------------------------|
| 274. Black cobalt-ochre | 276. Yellow cobalt-ochre |
| <i>a.</i> Earthy | 277. Red cobalt-ochre |
| <i>b.</i> Indurated | <i>a.</i> Cobalt-crust |
| 275. Brown cobalt-ochre | <i>b.</i> Cobalt-bloom |

16. ARSENIC GENUS.

- | | |
|-------------------------|--------------------|
| 278. Native arsenic | 280. Orpiment |
| 279. Arsenic pyrites | <i>a.</i> Yellow |
| <i>a.</i> Common | <i>b.</i> Red |
| <i>b.</i> Argentiferous | 281. Arsenic bloom |

17. MOLYBDENA GENUS.

282. Molybdena

18. SHEELE GENUS.

- | | |
|---------------|--------------|
| 283. Tungsten | 284. Wolfram |
|---------------|--------------|

19. MENACHINE GENUS

- | | |
|------------------|---------------------------|
| 285. Menachan | 289. Iserine |
| 286. Octahedrite | 290. Brown menachine-ore |
| 287. Rutile | 291. Yellow menachine-ore |
| 288. Nigrine | |

20. URAN GENUS.

- | | |
|----------------|-----------------|
| 292. Pitch-ore | 294. Uran-ochre |
| 293. Uran-mica | |

21. CHROME GENUS.

- | | |
|-------------------|-------------------|
| 295. Acicular-ore | 296. Chrome-ochre |
|-------------------|-------------------|

22. CERIUM GENUS.

297. Cerium-stone.

CLARKE'S
MINERAL SYSTEM IN 1818*.

CLASS I.—METALLIC COMBUSTIBLES.

Order I. *Existing only as Oxides in our Atmosphere.*

Genus 1. OXIDE OF CALCIUM OR LIME.

- | | |
|---|---|
| Spec. 1. Oxide of Calcium
with Carbonic Acid
Calcareous Spar, &c. | Spec. 4. Oxide of Calcium with
Phosphoric Acid
Apatite, &c. |
| 2. Oxide of Calcium with
Sulphuric Acid
Gypsum, &c. | 5. Oxide of Calcium with
Arsenic Acid
Pharmacolite |
| 3. Oxide of Calcium with
Fluoric Acid
Fluor Spar, &c. | |

Genus 2. OXIDE OF MAGNESIUM.

- | | |
|---|--|
| Spec. 1. Oxide of Magnesium
with Water | Spec. 2. Oxide of Magnesium
with Boracic Acid
Boracite |
|---|--|

Genus 3. OXIDE OF BARIUM.

- | | |
|--|---|
| Spec. 1. Oxyde of Barium with
Sulphuric Acid
Heavy Spar, &c. | Spec. 2. Oxyde of Barium with
Carbonic Acid
Witherite |
|--|---|

Genus 4.

* This View is extracted from Dr Clarke's Syllabus to his Lectures on Mineralogy.

Genus 4. OXIDE OF STRONTIUM.

- | | |
|---|---|
| Spec. 1. Oxide of Strontium
with Carbonic Acid
Strontianite | Spec. 2. Oxide of Strontium
with Sulphuric Acid
Celestine |
|---|---|

Genus 5. OXIDE OF ALUMINUM.

- | | |
|---|--|
| Spec. 1. Oxide of Aluminum
with Sulphuric Acid
Subsulphate of Alumine. | Spec. 5. Oxide of Aluminum,
and Oxide of Silicium,
with Fluoric Acid
Topaz, &c. |
| 2. Oxide of Aluminum,
Mellitic Acid and
Water
Honeystone | 6. Oxide of Aluminum,
Oxide of Magnesium,
and Chromic
Acid
Spinelle, &c. |
| 3. Oxide of Aluminum,
with Fluoric Acid,
and Oxide of Sodium
Cryolite | 7. Oxide of Aluminum,
with Oxide of Silicium
Sapphire, &c. |
| 4. Oxide of Aluminum,
Water, Fluoric Acid,
and Oxide of Calcium
Wavellite, &c. | 8. Oxides of Aluminum,
Silicium, and Iron
Tourmaline, &c. |
| | 9. Oxides of Aluminum,
Magnesium, and Silicium
Cyanite |

Genus 6. OXIDE OF ZIRCONIUM.

- Spec. 1. Oxides of Zirconium and Silicium.
Zircon

Genus 7. OXIDE OF YTTRIUM.

- Spec. 1. Oxides of Yttrium, Silicium, and Iron.
Gadolinite

Genus 8. OXIDE OF SILICIUM.

- | | |
|---|--|
| <p>Spec. 1. Oxide of Silicium almost pure
Quartz, &c.</p> <p>2. Oxide of Silicium and Water
Opal, &c.</p> <p>3. Oxides of Silicium, Aluminum, Iron, and Potassium or Sodium
Mica, &c.</p> <p>4. Oxides of Silicium, Aluminum, and Glucinum
Emerald, &c.</p> <p>5. Oxides of Silicium, Aluminum, and Barium
Harmotome, &c.</p> <p>6. Oxides of Silicium, Calcium, Potassium, and Water
Apophyllite, &c.</p> <p>7. Oxides of Silicium, Aluminum, Potassium or Sodium, and Water
Mesotype, &c.</p> | <p>Spec. 8. Oxides of Silicium, Calcium, Aluminum, and Iron
Garnet, &c.</p> <p>9. Oxides of Silicium, Calcium, Aluminum, Magnesium, and Chromate of Iron
Diallage</p> <p>10. Oxides of Silicium, Magnesium, Calcium, and Water
Meerschaum, &c.</p> <p>11. Oxides of Silicium, Magnesium, Calcium, and Aluminum
Asbestos, &c.</p> <p>12. Oxides of Silicium, Calcium, Magnesium, Aluminum, and Iron
Pyroxene, &c.</p> <p>13. Oxides of Silicium, Copper, and Water
Dioptase</p> |
|---|--|

Order II. *Reguline in our Atmosphere.*

Genus 1. GOLD.

- Spec. 1. Gold with minute proportions of Silver and Copper.
Native Gold, &c.

Genus 2.

Genus 2. PLATINUM.

Spec. 1. Platinum with Palladium, Rhodium, Iridium, Osmium, and minute proportions of other metals.

Genus 3. SILVER.

- | | |
|---|---|
| Spec. 1. Silver, with very minute proportions of other metals | Spec. 4. Silver with Arsenic Arsenical Silver-ore |
| Native Silver | 5. Silver with Sulphur Vitreous Silver, &c. |
| 2. Silver with Gold | 6. Silver with antimony, Sulphur, and Oxygen |
| Auriferous Native Silver | Red Silver |
| 3. Silver with Antimony | 7. Silver with Muriatic Acid |
| White Silver-ore | Horn Silver |

Genus 4. MERCURY.

- | | |
|------------------------------|-------------------------------|
| Spec. 1. Mercury almost pure | Spec. 3. Mercury with Sulphur |
| Native Quicksilver | Native Cinnabar |
| 2. Mercury with Silver | 4. Mercury with Muriatic Acid |
| Native Amalgam | Horn Quicksilver |

Genus 5. COPPER.

- | | |
|---------------------------------|---|
| Spec. 1. Copper almost pure | Spec. 4. Copper with Iron and Sulphur |
| Native Copper | Grey Copper |
| 2. Copper with Arsenic | 5. Copper with Oxygen |
| White Copper-ore of Freyberg | Ruby Copper |
| 3. Copper with Sulphur and Iron | 6. Copper with Carbonic Acid, Oxygen, and Water |
| Vitreous Copper-ore, &c. | Azure Copper, &c. |
| Vol. I. | 7. Copper |

- | | |
|---|---|
| <p>7. Copper with Oxygen
Muriatic Acid, . and
Water
Green Sand of Peru</p> <p>8. Copper with Oxygen
and Phosphoric
Acid</p> | <p>Green Phosphate of
Copper</p> <p>9. Copper with Oxygen,
Arsenic Acid, and
Water
Arseniated Copper, &c.</p> |
|---|---|

Genus 6. IRON.

- | | |
|---|--|
| <p>Spec. 1. Iron with Nickel
Native Iron</p> <p>2. Iron with Arsenic
Mispickel, &c.</p> <p>3. Iron with Oxygen
Magnetic Ironstone,
&c.</p> <p>4. Iron with Arsenic Acid,
Oxygen, Copper,
Water, and Silica
Green Cubic Iron</p> | <p>5. Iron with Phosphoric
Acid, Oxygen, and
Manganese
Native Prussian Blue,
&c.</p> <p>6. Iron with Oxygen and
Carbonic Acid
Spathose, or Sparry
Iron</p> |
|---|--|

Genus 7. TIN.

- | | |
|--|--|
| <p>Spec. 1. Tin with Oxygen
Tinstone</p> | <p>Spec. 2. Tin with Sulphur and
Copper
Pyritous Tin</p> |
|--|--|

Genus 8. LEAD.

- | | |
|---|--|
| <p>Spec. 1. Lead with Oxygen
Native Minium</p> <p>2. Lead with Sulphur
Galena</p> | <p>3. Lead with Antimony,
Copper, and Sulphur
Triple Sulphuret of
Lead</p> |
|---|--|

- | | |
|---|--|
| Spec. 4. Lead with Oxygen and
Carbonic Acid
White Lead-spar | and a small portion of
Muriatic Acid
Green Lead |
| 5. Lead with Muriatic
Acid, and Carbonic
Acid
Murio-carbonate of
Lead | Spec. 8. Lead with Oxygen and
Molybdcic Acid
Yellow Lead |
| 6. Lead with Oxygen
and Sulphuric Acid
Sulphate of Lead | 9. Lead with Oxygen and
Chromic Acid
Red Lead of Siberia |
| 7. Lead with Oxygen,
Phosphoric Acid, | 10. Lead with Oxygen, and
Oxide of Chromium
Green Chromal Lead |

Genus 9. NICKEL.

- | | |
|--|---|
| Spec. 1. Nickel almost pure
Capillary Native Nickel | Spec. 4. Nickel with Arsenic
Acid, Cobalt, and Alu-
mine
Arseniate of Nickel |
| 2. Nickel with Arsenic
Kupfer Nickel | |
| 3. Nickel with Oxygen
Nickel-ochre | |

Genus 10. ZINC.

- | | |
|--|--|
| Spec. 1. Zinc with Oxygen, and
the Oxides of Man-
ganese and Iron
Red Oxide of Zinc | Siliciferous Oxide of
Zinc |
| 2. Zinc with Sulphur and
Iron
Blende | 4. Zinc with Oxygen and
Carbonic Acid
Calamine |
| 3. Zinc with Oxygen and
Silex | 5. Zinc with Oxygen, Car-
bonic Acid, and
Water
Hydrous Carbonate |

Genus 11. BISMUTH.

- | | |
|---|--|
| Spec. 1. Bismuth with a small
portion of Cobalt,
or Arsenic
Native Bismuth | Spec. 2. Bismuth with Sulphur
Common Sulphuret
3. Bismuth with Lead,
Copper, and Sulphur
Nadel-erz |
|---|--|

Genus 12. ANTIMONY.

- | | |
|--|---|
| Spec. 1. Antimony with a small
portion of Silver
Native Antimony
2. Antimony with Sul-
phur
Grey Antimony | Spec. 3. Antimony with Oxygen
White Antimony
4. Antimony with Oxygen
and Sulphur
Red Antimony |
|--|---|

Genus 13. TELLURIUM.

- Spec. 1. Tellurium with Iron and Gold.
Native Tellurium, &c.

Genus 14. ARSENIC.

- | | |
|--|--|
| Spec. 1. Arsenic with Iron, Sil-
ver, or Gold
Native Arsenic
2. Arsenic with Sulphur
Realgar | Spec. 3. Arsenic with Oxygen
Native Oxide of Arsenic
4. Arsenic with Cobalt,
Iron, and Sulphur
Arsenical Cobalt, &c. |
|--|--|

Genus 15. COBALT.

- | | |
|---|--|
| Spec. 1. Cobalt with Oxygen
Black, Brown, and
Yellow Cobalt-ore | Spec. 2. Cobalt with Arsenic
Acid
Red Cobalt-ore |
|---|--|

Genus 16. MANGANESE.

- | | |
|--|---|
| Spec. 1. Manganese with Oxy-
gen
Radiated Grey Ore of
Manganese | Spec. 2. Manganese with Oxy-
gen and Sulphur
Black Ore of Mangan-
nese |
|--|---|

Spec. 3.

- | | |
|--|---|
| Spec. 3. Manganese with Oxygen, Oxide of Iron, and Phosphoric Acid
Phosphate of Manganese | 4. Manganese with Oxygen, Oxide of Silicon, and Oxide of Iron
Red Ore of Manganese of Nagyag |
|--|---|

Genus 17. TUNGSTEN.

- | | |
|--|---|
| Spec. 1. Tungsten with Oxygen and Oxide of Calcium
Tungspär | Spec. 2. Tungsten with Oxygen, Manganese, and Iron
Wolfram |
|--|---|

Genus 18. MOLYBDENUM.

- Spec. 1. Molybdenum with Sulphur.
 Molybdena

Genus 19. URANIUM.

- Spec. 1. Uranium with Oxygen.
 Pechblende, &c.

Genus 20. TITANIUM.

- | | |
|---|--|
| Spec. 1. Titanium with Oxygen
Titanite, &c.
2. Titanium Oxide, with Oxides of Iron, and | minute portions of other metals
Menachanite, &c.
3. Oxides of Titanium, Silicon, and Calcium
Sphene |
|---|--|

Genus 21. CHROMIUM.

- Spec. 1. Chromium with Oxygen, Oxide of Iron, and Oxide of Aluminum
 Chromite

Genus 22.

Genus 22. COLUMBIUM.

- | | |
|---|--|
| Spec. 1. Columbium Oxide,
with the Oxides
of Iron and Man-
ganese
Columbite | Spec. 2. Columbium Oxide,
with Oxides of Iron,
Manganese and Yt-
trium
Yttriferous Columbite |
|---|--|

Genus 23. CERIUM.

- Spec. 1. Cerium with Oxygen and Oxide of Silicium.
Cerite

CLASS II.—NON-METALLIC COMBUSTIBLES.

Order I. *Olcaginous*.

Genus 1. CARBON.

- | | |
|---|---|
| Spec. 1. Carbon with Hydro-
gen and Oxygen
Naphtha, &c. | Spec. 2. Carbon with Hydrogen,
Oxygen, and the
Oxides of Alumi-
num, Silicium, &c.
Cannel Coal, &c. |
|---|---|

Order II. *Not Olcaginous*.

Genus 1. CARBON.

- | | |
|---|---|
| Spec. 1. Carbon, almost pure
Diamond | Spec. 3. Carbon with Oxygen,
Silex, and Iron |
| 2. Carbon with Iron
Plumbago | Anthracite |

Genus 2. SULPHUR.

- | | |
|---|---|
| Spec. 1. Sulphur with Hydro-
gen
Native Sulphur | Spec. 2. Sulphur with Iron
Martial Pyrites |
|---|---|

CHARAC.

CHARACTERISTIC OR TABULAR VIEW
OF THE
CLASSES, ORDERS, GENERA, AND SPECIES
OF THE
MINERAL SYSTEM.

CHARACTERISTIC OR TABULAR VIEW
OF THE
CLASSES, ORDERS, GENERA AND SPECIES
OF THE
MINERAL SYSTEM.

1.

WHEN we wish to determine the *Species* to which any Mineral belongs, by means of the following Tabular View, we first ascertain either its primitive Form or Cleavage, and afterwards the Hardness and Specific Gravity. We next compare these characters with those in the *Classes, Orders, Genera* and *Species*; and if a *Species* in any of the *Genera* possesses the same characters, our mineral is to be considered as belonging to that species.

If the form or cleavage cannot be ascertained, our determination of the species will not be so satisfactory or certain. Thus, suppose we meet with a variety of Iron-pyrites, in which neither form nor cleavage can be detected, but of which the hardness and specific gravity are known; and that the hardness is 6, and the specific gravity 4.9. If we compare these characters with those of the *Classes, Orders, Genera* and *Species*,

cies, we shall find that the only Genus to which they apply is *Iron-Pyrites*. But these characters will not enable us to determine the Species with absolute certainty, because the essential character of every species depends on the primitive form. They will, however, shew that the mineral is Iron-pyrites, even that it is not Rhomboidal iron-pyrites ; but they will not enable us to decide whether it is Hexahedral or Prismatic iron-pyrites. In other cases, the species can be determined without knowing the primitive form ; but still, the determination is not so certain as when that form is known. Thus, suppose we meet with a species of Magnetic Iron-ore, which we find, by inspection, cannot be either the rhomboidal or prismatic species, but which agrees in hardness and specific gravity with the octahedral species, we can say that it very probably is a variety of Octahedral Magnetic Iron-ore. But there may be a fourth species of this genus not in the System, having the same hardness and specific gravity as the octahedral, but with a different primitive form ; and we cannot be certain that our mineral does not belong to that species. When the primitive form is known, all doubt vanishes. In compound minerals it is very often impossible to determine the external form. In such cases, a knowledge of the Cleavage is of infinite importance. But when neither form, nor hardness, nor specific gravity can be determined, the Tabular View can no longer be used ; for the principal characters on which it depends are wanting. Amianthus, which is a variety of straight-edged augite, (hornblende), occurs in crystals so very minute that they cannot be determined either by the eye or the microscope, and of course the cleavage is not visible. These crystals are flexible, and their hardness not capable of being determined. Their surface is so considerable in comparison of their mass, that they float on water, although they have a considerable specific gravity. It is remarked, that in other varieties of straight-edged augite, the crystals become thicker, then lose their flexibility, but are still too small for allowing the hardness

ness to be ascertained : Others, again, are thicker, but still, owing to their minuteness, the dimensions of the form cannot be measured : These sink in water, scratch gypsum, but break on calcareous-spar. At last, in other varieties, the form is discernible by the cleavage, and the hardness is equal to 5 and 6, and the specific gravity equal to 3.0. These, on examination, prove to be straight-edged augite. What these are, so are all the preceding varieties, and also amianthus. It is by pursuing this mode of examination, that we are able to refer such substances as amianthus to their true place in the System. Other minerals, again, which occur in an earthy state, can only be referred to their true place in the System, by tracing them in connection with compact minerals, which stand in connection with others having a crystallised structure. Thus Porcelain-earth can be traced to Compact felspar, and this to Foliated felspar ; or it can be traced immediately to Foliated felspar, and in this way its true place is ascertained. Other Earths, and loosely aggregated minerals, as many Clays, cannot be referred to any species ; these, therefore, are determined in an empirical way ; and we may use the blowpipe, acids, and other means, for obtaining a knowledge of their properties. These bodies are more properly objects of geological curiosity, and of economical value, than interesting to the Mineralogist.

2.

The nomenclature of the species used in the Tabular View, is nearly that of MOHS, and is founded on the primitive forms of the minerals, on the nature of their cleavage, or on the position of the bevelment.

According to Mohs, all the regular forms in the mineral kingdom are reducible to some one of four great systems or groupes, named Rhomboidal, Pyramidal, Prismatical, and Hexahedral or tessular, including octahedron, cube octahedron, rhomboidal dodecahedron, &c. Thus, in the genus Corundum,

dum, there are three species in which the primitive forms are the octahedron, rhomboid, and prism; and hence these are named, octahedral corundum, rhomboidal corundum, and prismatic corundum. In the genus Zeolite, there are seven species; one of these is named Prismatoidal zeolite, because the cleavage is prismatoidal; another is named Axifrangible, because one of its most striking characters is its axifrangible cleavage. In the genus Augite, one species is named Oblique-edged augite, because the edge formed by the meeting of the bevelling planes, on the extremities of the crystal, is placed obliquely to the axis of the prism; another species is named Straight-edged augite, because the edge formed by the bevelling planes on the extremity, is straight or perpendicular to the axis of the prism.

3.

In the generic characters, the number of axes of the Crystals is given. But it will be inquired, what is here understood by Axis. When the section of a simple figure, as a rhomboid or cube, affords, by means of a plane which does not pass through its centre, a regular, or equi-angular or equi-lateral figure, or one in which such a figure can be inscribed, the straight line, which stands perpendicular on the middle point of the figure, and passes through the centre of the figure, is an *axis*. If we take a hexahedron, and place it in such a situation that two only of its planes are horizontal, and the others vertical, every section of it, with a horizontal plane, will afford a square; and the vertical line, which stands perpendicular on the middle point of the square, and passes through the centre of the figure itself, will be an axis. Bring the same hexahedron in such a situation, that one of its solid angles is above, and another vertically under it. The section with a horizontal plane will be an equilateral triangle or equi-angular hexagon, and the straight line perpendicular on the middle point of this plane, and through the centre of the figure, an axis.

Lastly,

Lastly, If we place the hexahedron in such a situation, that four of its edges are horizontal, and the others are equally inclined towards the horizontal plane ; all the sections but two will be longish rectangles, and the straight line, perpendicular on the middle point, and through the centre of the figure, is an axis. —The kind of axis is determined by the figure of the section, and one and the same figure may contain not only many, but also axes of different kinds. That axis in which the form of the section is triangular, or in which a triangle can be inscribed by connecting some of its angles by straight lines, is named a *rhomboidal axis*, because it occurs in the rhomboid ; when the form of the section is a square, the axis is named *pyramidal*, because it occurs in the pyramid with square bases ; and when the form of the section is rhomboidal, the axis is named *prismatic*, because it occurs in the oblique double four-sided prism, which is a member of the prismatic series. In the Tabular View, the Diamond is said to have *many axes*, because its primitive figure, the octahedron, has rhomboidal axes that pass through the centre of the planes, pyramidal axes that pass through the angles, and six subordinate axes that pass through the middle point of the edges. Zircon is said to have one axis, because its primitive figure belongs to the pyramidal system, in which there is only one principal axis. Topaz has three axes, because it belongs to the prismatic series, in which there are three principal axes.

4.

The degrees of Hardness are expressed in the Tabular View by figures.

The following are the different degrees.

- | | |
|----|---------------------------------|
| 1. | Expresses the hardness of Talc. |
| 2. | Gypsum |
| 3. | Calcareous Spar |
| 4. | Fluor-Spar |
| 5. | Apatite |

6.	expresses the hardness of Felspar
7.	Quartz
8.	Topaz
9.	Corundum
10.	Diamond

Thus, if the hardness of a mineral is marked 7, it shews that it is equal to that of quartz. If the hardness is marked 7.5, it intimates that it is intermediate between that of quartz, and of the next number 8 or topaz. By using still smaller numbers, more minute degrees of hardness might be expressed.

CHARACTERS OF THE CLASSES.

CLASS I.—EARTHY MINERALS.

Tasteless.

Specific gravity above 1.8 *.

CLASS II.—SALINE MINERALS.

If solid, there is a sensible taste. No bituminous smell.

Specific gravity under 3.8.

CLASS III.—METALLIFEROUS MINERALS.

Tasteless.

Specific gravity above 1.8 †.

CLASS IV.

* All the specific gravities in this Tabular View, were taken by Professor Mohs, and may be depended on for their perfect accuracy. It will be seen that they occasionally differ from those in the body of the work.

† From the characteristic of the first and third Classes being the same, it is obvious that they should be arranged under one head, a method which is adopted by Professor Mohs.

CLASS IV.—INFLAMMABLE MINERALS.

If fluid, there is a bituminous smell. If solid, there is no taste.

Specific gravity under 1.8.

CHARACTERS OF THE ORDERS.**FIRST CLASS.—EARTHY MINERALS.****Order I.—GEM.**

No metallic lustre. Streak white.

Cleavage. If there are distinct cleavages, the hardness is equal to 8 and more; if only single imperfect cleavages, the hardness is equal to 7.5 and more; or the specific gravity is equal to 3.3 and more.

Hardness ranges from 5.5 to 10. At and below 6, the specific gravity is equal to 2.5 and less, and amorphous.

The specific gravity ranges from 2.0 to 4.7.

Order II.—SPAR.

No metallic lustre. No adamantine lustre. Streak white.

Hardness ranges from 3.5 to 7.0; if above 6, there are single distinct cleavages.

Specific gravity ranges from 2.0 to 3.7; if 2.4 and less, it is not amorphous*.

Order III.

* The cleavages not given, and therefore the characters of this order incomplete.

Order III.—MICA.

If no metallic lustre, the specific gravity is above 2.2. Streak neither yellow nor dark red. If the specific gravity is under 2.2, the lustre is perfectly metallic and shining.

Cleavage. It is distinctly axifrangible*, and prismatic†. The hardness ranges from 1 to 2.5.

Specific gravity ranges from 1.9 to 5.6.

Order IV.—MALACHITE.

No metallic lustre. Streak blue, green, brown. If white, the specific gravity is 2.2 and less. Colour not inclining to yellow.

Cleavage. It is neither distinctly axifrangible nor prismatic.

Hardness ranges from 2 to 5. If the streak is brown, the hardness is less than 3.5.

Specific gravity ranges from 2 to 4.6; if it is less than 3.2, the hardness is below 3.

Order V.—KERATE.

No metallic lustre. Streak colourless. Sectile.

Cleavage. It is neither distinctly axifrangible nor prismatic.

Hardness ranges from 1 to 2.

Specific gravity ranges from 4 to 6.

Order VI.—BARYTE.

No metallic lustre. Colour rarely changed in the streak; if orange-yellow, the specific gravity is 6 and more.

Hardness ranges from 2.5 to 5.

Specific gravity ranges from 3.3 to 7.2. If the specific gravity be less than 3.6, and the hardness 5, the cleavage is di-prismatic.

Order VII.

* In *axifrangible* minerals, the cleavage is at right angles to the prism.

† In *prismatic* minerals, there is but a single cleavage, and which is parallel with the side of the prism.

Order VII.—HALOIDE.

No metallic lustre. Streak not changed in the colour.

Cleavage. If in the direction of a four-sided prism, the hardness is equal to 4 and less; if axifrangible and prismatic, the hardness and specific gravity are below 3.

Hardness ranges from 1.5 to 5. If the hardness is less than 2.5, the specific gravity will be 2.4 and less. Divisible.

Specific gravity ranges from 2.2 to 3.2. If less than 2.4, the hardness will be 2.4 and less.

SECOND CLASS.—SALINE MINERALS.**Order I.—FOSSIL SALTS.**

Solid. Sensible taste.

THIRD CLASS.—METALLIFEROUS MINERALS.**Order I.—NATIVE METALS.**

Metallic lustre. White; yellow; red; grey: if steel-grey, is malleable.

Hardness ranges from 0 to 4.

Specific gravity ranges from 5.7 to 19.5.

Order II.—ORE.

If the lustre is metallic, the colour is pure black; if the lustre is not metallic, it is adamantine, or imperfect metallic. Streak black, brown, red, or white. If white, the hardness is equal to 5 and more, and the lustre is adamantine; or the specific gravity is equal to 4.6 and more: if red or brown, the hardness is equal to 3.5 and more.

Hardness ranges from 2.5 to 7. If 3 and less, the specific gravity is under 5 ; if 6.5 and more, and streak white, the specific gravity is 6 and more.

Specific gravity ranges from 3.4 to 7.4[†]

Order III.—PYRITES.

Lustre metallic. Not lead-grey. If pale steel-grey or white, the hardness is equal to 5 and more ; if dark steel-grey or black, the hardness is under 5, and the form tessular.

Hardness ranges from 3 to 6.5.

Specific gravity ranges from 4.1 to 7.7[†].

Order IV.—GLANCE.

Lustre metallic. Lead and steel grey ; black ; streak unchanged. If malleable, colour blackish lead-grey.

Hardness ranges from 1. to 3. If 3, is dark lead-grey.

Specific gravity ranges from 4 to 7.6. If less than 5, is pure lead-grey.

Order V.—BLENDE.

If the lustre is metallic, the colour is black, with a green streak. If not metallic, the lustre is adamantine. Streak brown, red, and white. If streak brown and white, it is tessular, with a hardness of 3.5 and more, and a specific gravity of 4.2 and less ; if streak red, the hardness is 2.5 and less, and the specific gravity 4.5 and more.

Hardness ranges from 1. to 4.

Specific gravity ranges from 3.9 to 8.2.

Order VI.—SULPHUR.

No metallic lustre. Streak red, yellow, or white. If the streak is white, the colour inclines to yellow or brown.

Cleavage.

* The characters of this Order incomplete.

† The characters of this Order incomplete.

Cleavage. If distinctly prismatic, the streak is yellow.

Hardness ranges from 1.0 to 2.5.

Specific gravity ranges from 1.9 to 3.6.

FOURTH CLASS.—INFLAMMABLE MINERALS.

Order I.—RESIN.

Fluid; solid; streak white; brown; black.

Hardness ranges from 0 to 2.5.

Specific gravity ranges from 0.7 to 1.6. If the specific gravity is 1.2 or more, the streak is white.

Order II.—COAL.

Solid. Streak brown; black.

Hardness ranges from 0.1 to 2.5.

Specific gravity from 1.2 to 1.5.

CHARACTERS OF GENERA AND SPECIES.

FIRST CLASS.—EARTHY MINERALS.

Order 1.—GEM.

Genus i.—DIAMOND.

Many axes. Cleavage tessular. Hardness = 10. Sp. gr. = 3.4, 3.6.

1. Octahedral.

Tessular. Cleavage octahedral.

Genus ii.—ZIRCON.

One axis. Cleavage pyramidal. Hardness=7.5. Sp. gr.=4.5, —4.7.

1. Pyramidal. *Zircon*.

Pyramid = $123^{\circ} 19'$; $84^{\circ} 20'$. Cleavage pyramidal, or in the direction of the lateral planes of the prism.

Genus iii.—CORUNDUM.

One and many axes. Cleavage rhomboidal; prismatic; octahedral. If prismatic, the specific gravity is 3.7 and more, and the hardness 8.5 and more. Hardness = 8.0,—9.0. Specific gravity = 3.5,—4.3.

1. Octahedral. *Spinel*, &c.

Tessular. Cleavage octahedral. Hardness=8. Sp. gr.=3.5,—3.8.

2. Rhomboidal. *Sapphire*, &c.

Rhomboid = $86^{\circ} 38'$. Cleavage in the direction of the rhomboid, or parallel with the terminal planes of the regular six-sided prism. Hardness = 9. Sp. gr. = 3.8,—4.3.

3. Prismatic. *Chrysoberyl*.

Prism = $104^{\circ} 41'$. Cleavage prismatoidal, in the direction of the smaller diagonal of the oblique four-sided prism. Hardness=8.5. Sp. gr.=3.7,—3.8.

Genus iv.—ANDALUSITE.

Three axes. Cleavage prismatic, slightly oblique. No single perfect cleavages. Hardness = 7.5. Sp. gr. = 3.0,—3.2.

1. Prismatic.

Prism unknown. Cleavage indeterminate diagonal.

Genus v.—TOPAZ.

Three axes. Cleavage axifrangible. Hardness=8. Sp. gr. = 3.4,—3.6.

1. Prismatic.

Prism = $124^{\circ} 22'$.

Genus vi.

Genus vi.—EMERALD.

One and three axes. Cleavage prismatic, rhomboidal. If rhomboidal, cleavage is imperfect axifrangible, and Sp. gr.=2.8 and less. Hardness ranges from 7.5 nearly to 8.0. Sp. gr. from 2.6 to 3.2.

1. Prismatic. *Euclase*.

Prism= $133^{\circ} 24'$. Cleavage prismatic, in the direction of the smaller diagonal. Hardness = 7.5. Sp. gr.=3.0,—3.2.

2. Rhomboidal. *Emerald*.

Di-rhomboid= $138^{\circ} 35'$; 90° . Cleavage most distinct, parallel with the terminal planes of the regular six-sided prism, less distinct in the direction of the lateral planes of the prism. Hardness = 7.5,—8.0. Sp. gr. = 2.6,—2.8.

Genus vii.—TOURMALINE.

One axis. Cleavage rhomboidal. Hardness=7.0,—7.5. Sp. gr. = 3.0,—3.2.

1. Rhomboidal.

Rhomboid= $133^{\circ} 36'$. The cleavage is most distinct in the direction of the planes of the rhomboid; less so in the direction of the lateral planes of the six-sided prism.

Genus viii.—CHRYSLITE.

Three axes. Cleavage parallel with the sides of a rectangular prism; and of these cleavages one is more perfect than the others. Vitreous lustre. Green. Hardness=6.5,—7.0. Sp. gr. = 3.3,—3.5.

1. Prismatic.

Prism= $131^{\circ} 48'$. Cleavage perfect, in direction of the smaller diagonal.

Genus ix.—AXINITE.

Three axes. Cleavage prismatic, very oblique. No perfect single cleavages. Not green. Hardness=6.5,—7.0. Sp. gr.=3.0,—3.3.

1. Prismatic

1. Prismatic.

Prism = $116^{\circ} 54'$. Cleavage straight prismatic = $101^{\circ} 30'$.

Genus x.—GARNET.

One and many axes. Cleavage pyramidal; prismatoidal; dodecahedral. If prismatoidal, the hardness is = 7 and more, and no pure vitreous lustre. Hardness ranges from 6.5 to 7.5 Sp. gr. from 3.3 to 4.3. If black, the sp. gr. is = 3.8 and less.

1. Pyramidal. *Vesuvian*.

Pyramid = $129^{\circ} 30'$; $74^{\circ} 12'$. Cleavage in the direction of the lateral planes of the prism; in the direction of the diagonals of the prism; and also in direction of the terminal planes of the prism. Hardness = 6.5. Sp. gr. = 3.3,—3.4.

2. Dodecahedral. *Garnet*.

Tessular. Cleavage dodecahedral. Hardness = 7.0,—7.5. Sp. gr. = 3.5,—4.3.

3. Prismatic. *Grenatite*.

Prism = $129^{\circ} 30'$. Cleavage prismatoidal, in the direction of the smaller diagonal of the prism. Hardness = 7.0,—7.5. Sp. gr. = 3.3,—3.8.

Genus xi.—GADOLINITE.

Three axes. Cleavage unknown. Black. Streak, greenish-grey. Hardness = 6.5,—7.0. Sp. gr. = 4.0,—4.2.

1. Prismatic.

Prism = 100° nearly.

Genus xii.—IOLITE.

One axis. Cleavage rhomboidal. Hardness = 7. Sp. gr. = 2.56.

1. Prismato-rhomboidal.

Rhomboid unknown. Cleavage in the direction of the lateral and terminal planes of the regular six-sided prism.

Genus xiii.

Genus xiii.—QUARTZ.

One axis. Cleavage rhomboidal, not axifrangible. Hardness = 5.5,—7.0. Sp. gr. = 2,—2.7.

1. Rhomboidal. *Common Quartz*, &c.

Rhomboid = $76^{\circ} 2'$. Cleavage in the direction of the alternate planes of the double six-sided pyramid. Hardness = 7.0. Sp. gr. = 2.5, 2.7.

2. Indivisible. *Opal*, &c.

Form unknown. No cleavage. Hardness = 5.5,—7.0. Sp. gr. = 2.0,—2.4.

Genus xiv.—BORACITE.

Many axes. Cleavage tessular. Hardness = 7.0. Sp. gr. = 2.8. 3.0.

1. Octahedral.

Tessular. Cleavage octahedral.

Order II.—SPAR.

Genus i.—PREHNITE.

Three axes. Cleavage axifrangible. Hardness = 6.0,—7.0. Sp. gr. = 2.8,—3.0. Not blue.

1. Prismatic.

Prism = 103° . Cleavage axifrangible.

Genus ii.—DATOLITE.

Three axes. Cleavage prismatic, but detected with difficulty. Internally, lustre resinous. Not blue. Hardness = 5.0,—5.5. Sp. gr. = 2.9,—3.0.

1. Prismatic.

Prism = $109^{\circ} 28'$. Cleavage the same.

Genus iii.

Genus iii.—ZEOLITE.

Every kind of axis. Hardness ranges from 3.5 to 6.0. Sp. gr. from 2.0 to 2.5*.

1. Dodecahedral. *Leucite*.

Tessular. Cleavage hexahedral and dodecahedral. Hardness = 5.5,—6.0. Sp. gr. = 2.4,—2.5.

2. Hexahedral. *Analcime*.

Tessular. Cleavage hexahedral. Hardness = 5.5. Sp. gr. = 2.0,—2.2.

3. Rhomboidal. *Chabasite*.

Rhomboïd = $93^{\circ} 48'$. Cleavage rhomboidal. Hardness = 4.0,—4.5. Sp. gr. = 2.0,—2.1.

4. Pyramidal. *Cross-stone*.

Pyramid = $121^{\circ} 58'$; $86^{\circ} 36'$. Cleavage is either pyramidal, or is in the direction of the diagonals. Hardness = 4.5. Sp. gr. = 2.3,—2.4.

5. Di-prismatic. *Laumonite*.

Vertical prism = $98^{\circ} 12'$; horizontal prism in the direction of the smaller diagonal $121^{\circ} 34'$. Cleavage double. Hardness = 5. Sp. gr. = 2.3,—2.4.

6. Prismatic. *Mesotype*.

Prism = $91^{\circ} 25'$. Cleavage the same. Hardness = 5.0,—5.5. Sp. gr. = 2.0,—2.3.

7. Prismatoidal. *Stilbite*.

Prism = $99^{\circ} 22'$. Cleavage in the direction of the smaller diagonal very distinct. Hardness = 3.5,—4.0. Sp. gr. = 2.0,—2.2.

8. Axifrangible. *Apophyllite*.

Pyramid = Cleavage very distinctly axifrangible. Hardness = 4.5,—5.0. Sp. gr. = 2.3,—2.5.

Genus iv.

* The characters of this Genus are incomplete.

Genus iv.—AZURE-SPAR

Three axes. Cleavage prismatic and prismatoidal. Blue.
Hardness=5.0,—6.5. Sp. gr.=2.7,—3.1.

1. Prismatic. *Azurite and Haiiyne*.

Prism unknown. Cleavage prismatic. Lively colour. Hardness=5,—5.5.

2. Prismatoidal. *Blue-spar*.

Prism unknown. Cleavage prismatoidal. Pale colours.
Hardness=5.5, 6.0.

Genus v.—FELSPAR.

One and three axes. Cleavage in the direction of rectangular four and regular six-sided prisms. Imperfectly axi-frangible. Hardness=5.0,—6.0. Sp. gr.=2.5,—2.8.

1. Prismatic. *Common Felspar, &c.*

Prism=120°. The most distinct cleavage is that parallel with the terminal planes of the prism; other two less distinct, parallel with the lateral planes. Hardness=6.0. Sp. gr.=2.5,—2.8.

2. Pyramidal. *Scapolite, &c.*

Pyramid=136° 38'; 62° 56'. Cleavage is in the direction of the lateral planes and the diagonals of a rectangular four-sided prism. Hardness=5.0,—5.5. Sp. gr. = 2.5,—2.8.

3. Prismato Pyramidal. *Meionite*.

Pyramid=136° 22', 63° 22'. Cleavage in the direction of the diagonals of the prism. Hardness = 5.5. Sp. gr. = 2.5,—2.7.

4. Rhomboidal. *Nepheline*.

Di-rhomboid = 152° 44'; 56° 15'. Cleavage is fourfold. Three of the cleavages are parallel with the lateral planes, and one with the terminal planes, of the six-sided prism. Hardness=6.0. Sp. gr.=2.5,—2.6.

Genus vi.

* *Lapis Lazuli* and *Calaité* belong to this Genus, but their specific characters have not been accurately ascertained.

Genus vi.—SPODUMEN.

Three axes. Cleavage prismatic. Three cleavages parallel with the axis, nearly of equal perfection. Hardness = 6. Sp. gr. = 3.0,—3.1.

1. Prismatic.

Prism nearly = 100° . Cleavage threefold; two of the cleavages parallel with the lateral planes, and a third with the shorter diagonal of the basis of the prism.

Genus vii.—KYANITE.

Three axes. Cleavage prismatic. On the most perfect cleavages, the hardness is = 5; on the angles, it is = 7. Specific gravity = 3.5,—3.7.

1. Prismatic.

Prism = $102^\circ 50'$. Cleavage prismatoidal.

Genus viii.—AUGITE.

Three axes. Cleavage prismatic. No metallic pearly lustre. If common lustre on single cleavages, the hardness is = 6 and more, and specific gravity below 3.5. If the lustre is resinous, the specific gravity = 3.2 and more. Not blue. Hardness ranges from 4.5 to 7.0. If the hardness is 6.0 and more, the specific gravity = 3.2 and more. Specific gravity ranges from 2.7 to 3.6.

1. Oblique-edged. *Augite*.

Prism = $92^\circ 18'$. Cleavage indeterminate diagonal. Hardness = 5.0,—6.0. Sp. gr. = 3.2,—3.5.

2. Straight-edged Augite. *Hornblende*.

Prism = $124^\circ 34'$. Cleavage indeterminate diagonal. Hardness = 5.0,—5.5. Sp. gr. = 2.7,—3.2.

3. Prismatoidal. *Epidote*.

Prism = $114^\circ 37'$. Cleavage sometimes prismatoidal. Hardness = 6.7. Sp. gr. = 3.2,—3.5.

4. Prismatic

4. Prismatic. *Tabular Spar.*

Prism = 105° nearly. Cleavage indeterminate diagonal.
Hardness = 4.5,—5.0. Sp. gr. = 2.8,—2.9.

Genus ix.—SCHILLER-SPAR.

Three axes. Cleavage prismatic. Pearly lustre on single cleavages. If common pearly lustre, the specific gravity = 3.2 and less, the hardness = 5.5 and less, and colour green. Hardness ranges from 4 to 6.; Sp. gr. from 3.0 to 3.4.

1. Green Diallage.

Prism unknown. Cleavage prismatoidal. Common pearly lustre. Hardness = 4.5,—5.5. Sp. gr. = 3.0,—3.2.

2. Schiller-Spar.

Prism nearly 100° . Cleavage prismatoidal. Metallic-like pearly lustre. Hardness = 4.0,—5.0. Sp. gr. = 3.0,—3.3.

3. Hyperstene.

Prism nearly 100° . Cleavage prismatoidal. Metallic-like pearly lustre. Hardness = 6.0. Sp. gr. = 3.3,—3.4.

4. Anthophyllite.

Prism nearly 106° . Cleavage in the direction of a rectangular prism. The lustre nearly metallic-like pearly. Hardness = 5.0,—5.5. Sp. gr. = 3.0,—3.3.

Order III.—MICA.

Genus i.—COPPER-MICA.

Three axes. Cleavage prismatic. Streak green. Hardness = 2.0. Sp. gr. = 2.5,—2.6.

1. Prismatic.

Prism unknown. Cleavage prismatic.

Genus ii.—URANITE or URAN-MICA.

One axis. Cleavage pyramidal; streak green. Hardness = 2.0,—2.5. Sp. gr. = 3.1,—3.3.

1. Pyramidal,

1. Pyramidal.

Pyramid = $95^{\circ} 13'$; $144^{\circ} 56'$. The only distinct cleavage is that parallel with the base of the prism.

Genus iii.—RED COBALT OR COBALT-MICA.

Three axes. Cleavage prismatic. Streak red; green. Hardness = 2.5. Sp. gr. = 4, 4.3.

1. Prismatic. *Cobalt-Bloom*.

Prism unknown. Cleavage prismatoidal.

Genus iv.—WHITE ANTIMONY OR ANTIMONY-MICA.

Three axes. Cleavage prismatic. Hardness = 1.5,—2.0. Sp. gr. = 5.0,—5.6.

1. Prismatic.

Prism unknown. Cleavage prismatic.

Genus v.—BLUE IRON.

Three axes. Cleavage prismatic. Streak white? Hardness = 2.0. Sp. gr. = 2.8,—3.0.

1. Prismatic.

Prism unknown. Cleavage prismatoidal.

Genus vi.—GRAPHITE.

One axis. Cleavage rhomboidal. Streak black. Hardness = 1.0,—2.0. Sp. gr. = 1.9,—2.1.

1. Rhomboidal.

Rhomboid unknown. Cleavage axifragible.

Genus vii.—MICA.

One axis. Cleavage rhomboidal. Streak green; white. Hardness = 1.0,—2.5. Sp. gr. = 2.7,—3.0.

1. Rhomboidal. *Mica, Chlorite, &c.*

Rhomboid unknown. Cleavage parallel with the terminal planes of the regular six-sided prism.

Genus viii.

Genus viii.—PEARL-MICA.

One axis. Cleavage rhomboidal. Streak white. Hardness = 3.5. Sp. gr. \approx 3.0,—3.1.

1. Rhomboidal.

Rhomboid unknown. Cleavage is parallel with the terminal planes of the regular six-sided prism.

Order IV.—MALACHITE.

Genus i.—COPPER-GREEN.

Reniform; botryoidal. Streak white. Hardness = 2.0,—3.0. Sp. gr. = 2.0,—2.2.

1. Common Copper-Green.

No cleavage.

Genus ii.—MALACHITE.

Three axes. Cleavage prismatic. Streak blue*; green; very pure. Hardness = 3.5,—4.0. Sp. gr. = 3.5,—3.7.

1. Prismatic. *Blue Copper*.

Prism = Cleavage uncertain. Streak blue.

2. Acicular. *Common Malachite*.

Prism = Cleavage uncertain. Streak green.

Genus iii.—OLIVENITE.

Many axes. Cleavage prismatic; tessular: streak blue; green; brown. If streak green or blue, the specific gravity is = 4 and more, or = 3 and less.

Hardness ranges from 2.5 to 5.

Specific gravity from 2.8 to 4.6.

1. Prismatic. *Phosphat of Copper*.

Prism = 110°. Cleavage the same. Streak emerald-green. Hardness = 5. Sp. gr. = 4.0,—4.3.

2. Di-prismatic

* The characters of Pearl-mica given above by Professor Mohs, contain all the information I possess of this mineral. This species is not included in the body of the work.

2. Di-prismatic. *Lenticular Copper.*

Prism unknown. Cleavage in the direction of the lateral and terminal bevelling planes of an oblique four-sided prism. Streak pale verdigris-green, and sky-blue. Hardness = 2.5. Sp. gr. = 2.8,—2.9.

3. Acicular. *Olivenite.*

Prism unknown. Cleavage unknown. Streak olive-green ; brown. Hardness = 3.0. Sp. gr. = 4.2,—4.6

4. Hexahedral. *Cube-ore.*

Tessular. Cleavage hexahedral. Streak olive-green ; brown. Hardness = 2.5. Sp. gr. = 2.9,—3.0.

Genus iv.—EMERALD-COPPER.

One axis. Cleavage rhomboidal. Streak Hardness = 5.0. Sp. gr. = 3.3,—3.4.

1. Rhomboidal.

Rhomboid = $123^{\circ} 58'$. Cleavage rhomboidal.

Order V.—KERATE.

Genus i.—CORNEOUS SILVER.

Three axes. Cleavage invisible. Hardness = 1.0,—2.0. Sp. gr. = 4.6.

1. Hexahedral.

Tessular. Cleavage not visible. Malleable.

Genus ii.—CORNEOUS MERCURY.

One axis. Cleavage very indistinct. Hardness = 1.0,—2.0. Sp. gr. =

1. Pyramidal.

Pyramid unknown. Cleavage indistinct axifrangible. Sec-tile.

Order VI.

Order VI.—BARYTE.

Genus i.—LEAD-SPAR.

One and three axes. Cleavage rhomboidal, pyramidal, prismatic. Hardness ranges from 2.5, to 4.0. If above 3.5, the specific gravity is, equal to 6.5 and more. Specific gravity ranges from 6.0 to 7.2.

1. Tri-prismatic. *Sulphat of Lead.*

The vertical prism $=120^\circ$; horizontal prism, in the direction of the longer diagonal, $=70^\circ 31'$; and in the smaller $=101^\circ 32'$. Cleavage is the same. Hardness = 3. Sp. gr. = 6.3.

2. Pyramidal. *Yellow Lead-spar.*

Pyramid $=99^\circ 40'$; $131^\circ 45'$. Cleavage in the direction of the faces of the pyramid, or in the direction of the terminal planes of the rectangular four-sided prism. Hardness = 3. Sp. gr. = 6.5, 6.8.

3. Prismatic. *Red Lead-spar.*

Prism unknown. Cleavage in the direction of a rectangular prism. Hardness = 2.5. Sp. gr. = 6.0, 6.1.

4. Rhomboidal. *Green and Brown Lead-spar.*

Di-rhomboid $=141^\circ 47'$; $81^\circ 46'$. Cleavage in the direction of the planes of the rhomboid, and in the direction of the lateral planes of the six-sided prism. Hardness = 3.5, 4.0. Sp. gr. = 6.9, 7.2.

5. Di-prismatic. *White Lead-spar.*

Vertical prism $=117^\circ 4'$. Horizontal prism in the direction of the smaller diagonal $=109^\circ 30'$. Cleavage the same. Hardness = 3.0, 3.5. Sp. gr. = 6.2, 6.6.

Genus ii.—BARYTE.

One and three axes. Cleavage rhomboidal and prismatic. If cleavage rhomboidal, the specific gravity is 4.2 and more. Hardness = 3.0, 3.5. Sp. gr. = 3.6, 4.6.

1. Rhomboidal.

1. Rhomboidal. *Witherite*.

Rhomboid = $91^{\circ} 54'$. The most distinct cleavage is in the direction of the planes of the rhomboid, and a less distinct cleavage parallel with the alternate planes of the six-sided pyramid. Hardness = 3.0, 3.3. Sp. gr. = 4.2, 4.4.

2. Prismatic. *Heavy-spar*.

Prism = $101^{\circ} 53'$. The most distinct cleavage is that parallel with the terminal planes of the oblique four-sided prism; less perfect are those parallel with the lateral planes of the prism. Hardness = 3, 3.5. Sp. gr. = 4.1, 4.6.

3. Di-prismatic. *Strontianite*.

Vertical prism = $117^{\circ} 19'$. Horizontal prism in the direction of the smaller diagonal = . Cleavage in the direction of the planes of both prisms. Hardness = 3.5. Sp. gr. = 3.6, 3.8.

4. Axifrangible. *Celestine*.

Prism = $104^{\circ} 48'$. The most distinct cleavage is that at right angles to the axis of the prism; another less distinct cleavage is parallel with the lateral planes of the prism. Hardness = 3.0, 3.3. Sp. gr. = 3.6, 4.0.

Genus iii.—TUNGSTEN.

One axis. Cleavage pyramidal. Hardness = 4.0, 4.5. Sp. gr. = 6.0, 6.1.

1. Pyramidal.

Pyramid = $107^{\circ} 26'$; $113^{\circ} 36'$. The most distinct cleavage is that parallel with the planes of the primitive pyramid; another less distinct in which the planes are parallel with the sides of an acute pyramid, ($100^{\circ} 8'$; $130^{\circ} 20'$); and a third the least distinct, parallel with the common base of the pyramid*.

Genus iv.

* At page 435, vol. ii. it is stated, through mistake, that this last cleavage is the most perfect.

Genus iv.—CALAMINE.

One and three axes. Cleavage di-prismatic; rhomboidal. If rhomboidal, the sp. gr. = 4.2 and more. Hardness = 5.0. Sp. gr. = 3.3,—4.5.

1. Prismatic. *Electric Calamine.*

Vertical prism = $99^{\circ} 56'$. Horizontal prism, in the direction of the longest diagonal, = 120° . Cleavage is the same. Hardness = 5.0. Sp. gr. = 3.3,—3.6.

2. Rhomboidal. *Common Calamine.*

Rhomboid about 110° . The cleavage is in the direction of the planes of the rhomboid. Hardness = 5.0. Sp. gr. = 4.2,—4.4.

Genus v.—RED MANGANESE.

One axis. Cleavage rhomboidal. Hardness = 3.5,—4.5. Sp. gr. = 3.3,—3.9.

1. Rhomboidal.

Rhomboid = Cleavage rhomboidal. Hardness = 3.5. Sp. gr. = 3.3,—3.6.

Genus vi.—SPARRY IRON.

One axis. Cleavage rhomboidal. Hardness = 3.5,—4.6. Sp. gr. = 3.6,—3.9.

1. Sparry Iron.

Rhomboid = 107° . The most perfect cleavage is in the direction of the planes of the primitive rhomboid; the least perfect in the direction of the planes of a flat rhomboid. Hardness = 3.5,—4.5. Sp. gr. = 3.6,—3.9.

Order VII.—HALOIDE.

Genus i. LIMESTONE.

One and three axes. Cleavage prismatic; rhomboidal. Hardness ranges from 3.0 to 4.5. Sp. gr. = 2.5,—3.2*.

1. Rhomb

* The characters of this genus are incomplete.

1. Rhomb-Spar.

Rhomboid = $106^{\circ} 15'$. Cleavage rhomboidal. Hardness = 3.5,—4.0. Sp. gr. = 2.8,—3.2.

2. Dolomite.

Rhomboid = $107^{\circ} 22'$. Cleavage rhomboidal. Hardness = 4.0,—4.5, Sp. gr. = 3.0,—3.2.

3. Limestone.

Rhomboid = $105^{\circ} 5'$. The most perfect cleavage is in the direction of the primitive rhomboid: less perfect cleavage in the direction of a flatter rhomboid; a third, still more imperfect, which is parallel with the planes of the six-sided prism; and a fourth, the most imperfect, which is parallel with the terminal planes of the six-sided prism. Hardness = 3.0. Sp. gr. = 2.5,—2.8.

4. Prismatic. *Arragonite*.

Vertical prism = $115^{\circ} 56'$: horizontal prism in the direction of the shorter diagonal $109^{\circ} 28'$. The cleavage is the same, but most distinct in the direction of the smaller diagonal of the vertical prism. Hardness = 3.5,—4.0. Sp. gr. 2.6,—3.0.

Genus ii. APATITE.

One axis. Cleavage rhomboidal. Hardness = 5.0. Sp. gr. = 3.1,—3.2.

1. Rhomboidal.

Di-rhomboid = $131^{\circ} 49'$; $109^{\circ} 28'$. The most perfect cleavage is parallel with the terminal planes of a regular six-sided prism; and another, less distinct, parallel with the sides of the six-sided prism. Hardness = 5.0.

Genus iii. FLUOR.

Many axes. Cleavage octahedral. Hardness = 4.0. Sp. gr. = 3.0,—3.1.

1. Octahedral.

Tessular. Cleavage octahedral. Hardness = 4.0.

Genus iv.

Genus iv.—ALUM-STONE.

One axis. Cleavage rhomboidal. Hardness = 5.0. Sp. gr. = 2.4,—2.6.

1. Rhomboidal.

Rhomboid unknown. The most distinct cleavage parallel with the sides of a rhomboid; another, less distinct, parallel with the terminal planes of a six-sided prism.

Genus v.—CRYOLITE.

One axis. Cleavage pyramidal. One perpendicular cleavage, and other two less perfect. Hardness = 2.5,—3.0. Sp. gr. = 2.9,—3.0,

1. Pyramidal.

Pyramid unknown. The most perfect cleavage is parallel with the terminal planes of a rectangular four-sided prism; another, less distinct, parallel with the diagonals of a rectangular four-sided prism; and a third, still less perfect, parallel with the planes of the pyramid.

Genus vi.—GYPSUM.

Three axes. Cleavage prismatic. Hardness = 1.5,—3.5. Sp. gr. = 2.2,—3.0*.

1. Prismatic. *Anhydrite*.

Prism = $100^{\circ} 8'$. Three cleavages perpendicular to each other. Hardness = 3.0,—3.5. Sp. gr. = 2.7,—3.0.

2. Axifrangible. *Gypsum*.

Prism = $113^{\circ} 8'$. Cleavage perpendicular to the axis or axifrangible. Hardness = 1.5,—2.0. Sp. gr. = 2.2,—2.4,

* The characters of this Genus incomplete.

CLASS II.—SALINE MINERALS.

Order I.—FOSSIL SALTS.

Genus i.—ROCK SALT.

Many axes. Cleavage tessular. Taste saline. Hardness = 2.0,—2.5. Sp. gr. = 2.1,—2.2,

1. Hexahedral.

Tessular. Cleavage hexahedral.

Genus ii.—SAL AMMONIAC.

Many axes. Cleavage tessular. Taste pungent and urinous. Hardness 1.5,—2.0. Sp. gr. = 1.5,—1.6.

1. Octahedral.

Tessular. Cleavage octahedral.

Genus iii.—VITRIOL.

One and three axes. Cleavage rhomboidal, pyramidal, and prismatic. Taste astringent. Hardness = 2.0,—2.5. Sp. gr. = 1.9,—2.2,

1. Rhomboidal. *Green Vitriol.*

Rhomboid = $81^{\circ} 23'$. The cleavage is rhomboidal. Hardness = 2.0. Sp. gr. = 1.9,—2.0.

2. Prismatic. *Blue Vitriol.*

Prism = $124^{\circ} 2'$. Cleavage same. Hardness = 2.5. Sp. gr. = 2.1,—2.2.

3. Pyramidal: *White Vitriol.*

Pyramid = $120^{\circ} 90'$. Cleavage unknown. Hardness = Sp. gr. = 2.0.

Genus iv.—EPSOM SALT.

Three axes. Cleavage prismatic. Taste saline and bitter. Hardness = Sp. gr. =

1. Prismatic.

1. Prismatic.

Prism = 90° . Cleavage very perfect in the direction of one of the diagonals.

Genus v.—ALUM.

Many axes. Cleavage tessular. Taste sweetish, astringent and acidulous. Hardness = 2.0,—2.5. Sp. gr. = 1.7,—1.8.

1. Octahedral.

Tessular. Cleavage octahedral.

Genus vi.—GLAUBER SALT.

Three axes. Cleavage prismatic. Taste cooling, saline, and bitter. Hardness = Sp. gr. = 2.2,—2.3.

1. Prismatic.

Prism unknown. Cleavage prismatic.

Genus vii.—NITRE.

Three axes. Cleavage prismatic. Taste saline and cooling. Hardness = 2.0. Sp. gr. = 1.9,—2.0.

1. Prismatic.

Prism = Cleavage in the direction of the shorter diagonal of the prism.

Genus viii.—NATRON.

Three axes. Cleavage prismatic. Taste pungent and alkaline. Hardness = Sp. gr. = 1.4.

1. Prismatic.

Prism unknown. Cleavage prismatic.

Genus ix.—BORAX.

Three axes. Cleavage prismatic. Taste alkaline and sweet. Hardness = Sp. gr. = 1.5,—1.7.

1. Prismatic.

Prism unknown. Cleavage prismatic.

CLASS III.—METALLIFEROUS MINERALS.

Order I.—NATIVE METALS.

Genus i.—PLATINA.

Form unknown. Cleavage either invisible or very imperfect
Colour steel-grey, or steel-grey inclining to silver-white. Sp.
gr. = 11.8 to 19.5.

1. Native Platina.

In grains and rolled pieces. Sp. gr. = 17.7.

2. Palladium.

Colour steel-grey, inclining to silver-white. Sp. gr. = 11.8,
-12.148.

3. Iridium.

Colour pale steel-grey. Sp. gr. = 19.5.

Genus ii.—GOLD.

Many axes. Cleavage not discernible. Colour gold-yellow ;
brass-yellow ; greyish-yellow ; brass-yellow, inclining to sil-
ver-white, Sp. gr. = 12.0.

1. Hexahedral.

Tessular.

Genus iii.—SILVER.

Many axes. Cleavage not discernible. Ductile ; malleable ;
silver-white. Sp. gr. = 10.0,—10.4.

1. Hexahedral.

Tessular.

Genus iv.—MERCURY.

Many axes. Fluid. Cleavage not discernible. Not malle-
able. White. Hardness = 0,—3.0. Sp. gr. = 10.5,—13.6.

1. Fluid.

1. Fluid.

Fluid. Tin-white. Hardness = 0. Sp. gr. = 13.4,—13.6.

2. Dodecahedral. *Native Amalgam.*

Tessular. Silver-white. Hardness = 1.3. Sp. gr. = 10.5.

Genus v.—COPPER.

Many axes. Cleavage not discernible. Copper-red. Sp. gr. = 8.4,—8.7.

1. Octahedral.

Tessular.

Genus vi.—IRON.

Many axes. Cleavage not discernible. Steel-grey, inclining to silver-white. Sp. gr. = 7.4,—7.6.

1. Octahedral.

Tessular.

Genus vii.—ARSENIC.

Form unknown. Cleavage unknown. Tin-white, inclining to lead-grey.* Hardness = 3.5. Sp. gr. = 5.7,—5.8.

1. Native.

Probably tessular.

Genus viii.—BISMUTH.

Many axes. Cleavage tessular. Malleable. White, inclining to red. Hardness = 2.0,—2.5. Sp. g. = 8.9.

1. Octahedral.

Tessular. Cleavage octahedral.

Genus ix.—ANTIMONY.

Many axes. Cleavage tessular. Not ductile. Pure white. Hardness = 3.0,—3.5. Sp. g. = 6.5, 10.0*.

* The characters of this Genus are incomplete.

1. Dodecahedral. *Native Antimony.*

Tessular. Cleavage octahedral and dodecahedral. Hardness 3.0,—3.5. Sp. gr. 6.5,—6.8.

2. Octahedral. *Antimonial and Arsenical Silver.*

Tessular. Cleavage octahedral. Hardness = 3.5. Sp. gr. = 8.9 *,—10.0.

Genus x.—TELLURIUM.

Form unknown. Cleavage unknown. Tin-white. Hardness = 2.0,—2.5. Sp. gr. 6.1,—6.2.

1. Native.

Probably tessular.

Order II.—ORE.

Genus i.—TITANIUM ORE.

One and three axes. Cleavage prismatic, and pyramidal. Streak white; brown; black. If the streak is brown, the hardness is = 6.0 and more. If the specific gravity is 4.4 and more, the streak is black, and the mineral is slightly magnetic. Hardness = 5.0,—6.5. Sp. gr. = 3.4,—4.8.

1. Prismatic. *Sphene.*

The vertical prism = $136^{\circ} 50'$. The horizontal prism in the direction of one of the diagonals = 120° . Streak white. Hardness = 5.0,—5.5. Sp. gr. = 3.4,—3.6.

2. Prismato-Pyramidal. *Rutile. Iserine. Menachine.*

Pyramid = $117^{\circ} 2'$; and $84^{\circ} 48'$. The most distinct cleavage is in the direction of the lateral planes of the rectangular four-sided prism; and another, less distinct, is parallel with the diagonals of the prism. The streak is brown; black. Hardness = 5.5,—6.5. Sp. gr. = 4.2,—4.8.

3. Pyramidal.

* The specific gravity of Mohs is lower than what is given in the text.

3. Pyramidal. *Octahedrite*.

Pyramid = $97^{\circ} 38'$; $137^{\circ} 10'$. The most perfect cleavage is in the direction of the faces of the pyramid; another, less perfect, is parallel to the common base of the pyramids. Streak white. Hardness = 5.5,—6.0. Sp. gr. = 3.8,—3.9.

Genus ii.—RED COPPER-ORE.

Many axes. Cleavage tessular. Streak red. Hardness = 3.5. Sp. gr. = 5.6,—6.0.

1. Octahedral.

Tessular. Cleavage octahedral.

Genus iii.—TIN-ORE.

One axis. Cleavage pyramidal. Streak not black. Hardness = 6.0,—7.0. Sp. gr. = 6.3,—7.0.

2. Pyramidal.

Pyramid = $133^{\circ} 36'$; $67^{\circ} 42'$. The most perfect cleavage is in the direction of the lateral planes of a rectangular four-sided prism: and another, less perfect, in the direction of the diagonals of the same prism.

Genus iv.—WOLFRAM.

Three axes. Cleavage prismatic. Streak dark reddish-brown. Hardness = 5.0,—5.5. Sp. gr. = 7.1,—7.4.

1. Prismatic.

Prism = 120° . There is always one distinct cleavage, which is parallel with the longer diagonal of the prism; and another, less distinct, in the direction of the shorter diagonal*.

Genus v.—TANTALUM-ORE.

Three axes. Cleavage unknown. Streak dark brownish-black.

* In the text, the most perfect cleavage is, through mistake, said to be parallel with the shorter diagonal.

black. Lustre nearly semi-metallic adamantine. Hardness = 6.0 under the file. Sp. gr. = 6.0,—6.3.

1. Prismatic.

Prism unknown.

Genus vi.—URANIUM-ORE.

Form unknown. Cleavage unknown. Streak black and glistening. Hardness = 5.5. Sp. gr. = 6.4,—6.6.

1. Indivisible.

Reniform. Massive.

Genus vii.—CERIUM-ORE.

Three axes. Cleavage either prismatic or invisible. No metallic lustre. Streak white ; grey. Hardness = 5.5. Sp. gr. = 3.5,—5.0.

1. Prismatic.

Prism = 117°. Sp. gr. = 5.3,—4.0.

2. Indivisible.

Massive. Hardness = 5.5. Sp. gr. = 4.6,—4.5.

Genus viii.—CHROME-ORE.

Three axes. Cleavage prismatic. Imperfect metallic lustre. Streak dark brown. Hardness = 5.5. Sp. gr. = 4.4,—4.5.

1. Prismatic.

Prism unknown. Cleavage imperfect.

Genus ix.—IRON-ORE.

One and many axes. Cleavage rhomboidal ; prismatic ; tessular. Streak black ; red ; yellowish ; brown. If the streak is black, it affects the magnet powerfully ; if the streak is brown, the hardness is = 5.5 and less. Hardness = 5.0,—6.5. Sp. gr. = 3.8,—5.2.

1. Octahedral.

1. Octahedral. *Magnetic Iron-Ore.*

Tessular. Cleavage octahedral. Streak black. Hardness = 5.5,—6.5. Sp. gr. = 4.8,—5.2.

2. Rhomboidal. *Iron-glance, and Iron-ore.*

Rhomboid = $87^{\circ} 9'$. The most perfect cleavage is parallel with the planes of the primitive rhomboid; and another, less perfect, which is parallel with the lateral planes of the six-sided prism or table. The streak is red, or reddish-brown. Hardness = 5.5,—6.5. Sp. gr. = 4.9,—5.2.

3. Prismatic. *Brown Iron-ore.*

Prism unknown. Cleavage prismatic. Streak yellowish-brown. Hardness = 5.0,—5.5. Sp. gr. = 3.8,—4.2.

Genus x.—MANGANESE-ORE.

Three axes. Cleavage prismatic. Streak black. No action on the magnet. Hardness = 2.5,—5.0? Sp. gr. 4.4,—4.8.

1. Prismatic. *Grey Manganese Ore, &c.*

Prism nearly = 100° . Cleavage the same, but most perfect in the direction of the longer diagonal.

Order III.—PYRITES.

Genus i.—NICKEL PYRITES. *Copper-Nickel.*

Three axes. Cleavage unknown. Copper-red. Hardness = 5.0,—5.5. Sp. gr. 7.5,—7.7.

1. Prismatic.

Prism unknown.

Genus ii.—ARSENICAL PYRITES.

Three axes. Cleavage prismatic. White, and pale steel-grey. If white, the specific gravity is = 6.2, and less; if steel-grey the specific gravity is = 6.9 and more. Hardness = 5.0,—6.0. Sp. gr. = 5.7,—7.4.

1. Prismatic.

1. Prismatic.

Prism unknown. Cleavage unknown. Steel-grey. Hardness = 5.0,—5.5. Sp. gr. 6.9,—7.4.

2. Di-prismatic. *Common Arsenical Pyrites.*

The vertical prism = $111^{\circ} 18'$. The horizontal prism =
Cleavage in the direction of the vertical prism.
Hardness = 5.5,—6.0. Sp. gr. = 5.7,—6.2.

Genus iii.—COBALT PYRITES.

Many axes. Cleavage tessular. White; also inclining to red and steel-grey. Hardness = 5.5. Sp. gr. = 6.0,—6.6.

1. Hexahedral. *Silver-white Cobalt.*

Tessular. Cleavage hexahedral. Sp. gr. = 6.1,—6.3.

2. Octahedral. *Tin white and grey Cobalt.*

Tessular. Cleavage octahedral, but in general very indistinct. Sp. gr. = 6.0,—6.6.

Genus iv.—IRON-PYRITES.

One and many axes. Cleavage rhomboidal; prismatic; tessular; bronze-yellow, occasionally inclining to copper-red. Hardness = 3.5,—6.5. Sp. gr. = 4.4,—5.0.

1. Hexahedral. *Common Iron-Pyrites.*

Tessular. Cleavage hexahedral. Hardness = 6.0,—6.5. Sp. gr. = 4.7,—5.0.

2. Prismatic. *Radiated Pyrites, &c.*

Prism = $106^{\circ} 36'$. Cleavage the same? Hardness = 6.0,—6.5. Sp. gr. = 4.7,—5.0.

3. Rhomboidal. *Magnetic Pyrite.*

Rhomboid unknown. The most perfect cleavage is in the direction of the terminal planes of a six-sided prism; and another, less perfect, in the direction of the lateral planes of a six-sided prism. Hardness = 3.5,—4.5. Sp. gr. = 4.4,—4.6.

Genus v.

Genus v.—COPPER-PYRITES.

Many axes. Cleavage tessular. Brass-yellow; steel-grey; iron-black. Hardness = 3.0,—4.0. Sp. gr. = 4.1, 4.9.

1. Octahedral. *Common Copper-Pyrites.*

Tessular. Cleavage probably octahedral. Brass-yellow. Hardness = 3.0,—4.0. Sp. gr. = 4.1,—4.2.

2. Tetrahedral. *Grey-Copper.*

Tessular. Cleavage probably octahedral. Steel-grey and iron-black. Hardness = 3.4. Sp. gr. = 4.4,—4.9.

Genus vi.—TIN-PYRITES.

Steel-grey, inclining to brass-yellow. Sp. gr. = 4.3,—5.0.

1. Compact.

Massive.

Order IV.—GLANCE.

Genus i.—COPPER-GLANCE.

One axis. Cleavage rhomboidal. Blackish lead-grey. Sectile, and nearly malleable. The intensity of the lustre, increased in the streak. Hardness = 2.5,—3.0. Sp. gr. 5.5,—5.8.

1. Rhomboidal.

Rhomboid unknown. The cleavage is in the direction of the lateral planes of a six-sided prism*.

Genus ii.—SILVER-GLANCE.

One and many axes. Cleavage rhomboidal, or not discernible. Blackish lead-grey, and iron-black. If blackish lead-grey, or the intensity of the lustre increased in the streak, it is malleable, and the sp. gr. = 6.9 and more.

Hardness = 2.0,—2.5. Sp. gr. = 5.7,—7.2.

1. Hexahedral.

* This determination differs a little from that given in the description of the species.

1. Hexahedral. *Vitreous Silver-Ore.*

Tessular. Cleavage not discernible. Sp. gr. = 6.9,—7.2.

2. Rhomboidal. *Brittle Silver-Glance.*

Rhomboid unknown. Sp. gr. = 5.7,—6.1.

Genus iii.—GALENA OR LEAD-GLANCE.

Many axes. Cleavage tessular. Pure lead-grey. Hardness = 2.5. Sp. gr. = 7,—7.6.

1. Hexahedral. *Common Galena.*

Tessular. Cleavage hexahedral.

Genus iv.—BLACK TELLURIUM.

Three axes. Cleavage perfect, according to one direction. Blackish lead-grey. Not malleable. Hardness = 1,—1.5. Sp. gr. = 7.0,—7.2.

1. Prismatic.

Prism unknown. Cleavage prismatoidal or axifrangible.

Genus v.—MOLYBDENA.

One axis. Cleavage rhomboïcal. Pure lead-grey. Flexible. Hardness = 1.—1.5. Sp. gr. = 4.4,—4.6.

1. Rhomboidal.

Rhomboid unknown. Single cleavage, parallel with the terminal planes of a six-sided prism, or the lateral planes of a six-sided table.

Genus vi.—GOLD-GLANCE.

Three axes. Cleavage prismatic; not axifrangible. Pure steel-grey. Hardness = 1.5,—2.0. Sp. gr. = 5.7,—5.8.

1. Prismatic Gold-Glance. *Graphic and Yellow Tellurium.*

Prism unknown. Cleavage prismatic.

Genus vii.—BISMUTH-GLANCE.

Three axes. Cleavage prismatic. Lead-grey. Hardness = 2.0,—2.5. Sp. gr. = 6.1,—6.4.

1. Acicular.

1. Acicular.

Prism unknown. Cleavage imperfect. Dark lead grey. Hardness = 2.0,—2.5. Sp. gr. = 6.1,—6.2.

2. Prismatic.

Prism unknown. The cleavage is parallel to the sides and to the short diagonal of an oblique four-sided prism. Lead-grey. Hardness = 2.0,—2.5. Sp. gr. = 6.1,—6.4.

Genus viii.—ANTIMONY-GLANCE.

Three axes. Cleavage prismatic. Lead-grey falling into blackish and steel-grey. If it passes into steel-grey, its cleavage is axifrangible; inflexible; sectile. If it passes into lead-grey, is brittle. Hardness = 2.3. Sp. gr. = 4.0,—5.8.

1. Prismatoidal. *Grey Antimony.*

Prism = . Cleavage perfect prismatic. Hardness = 2.0. Sp. gr. = 4.0,—4.6.

2. Axifrangible. *Bournonite.*

Prism unknown. Cleavage axifrangible. Its colour is blackish lead-grey, falling into steel-grey. Hardness = 2.0,—2.5. Sp. gr. 5.5,—5.8.

3. Prismatic.

Prism unknown. Cleavage in direction of the smaller diagonal. Blackish lead-grey. Hardness = 2.5,—3.0. Sp. gr. = 5.7,—5.8.

Order V.—BLENDE.

Genus i.—MANGANESE BLENDE. *Sulphuret of Manganese.*

Three axes. Cleavage prismatic. Streak greenish. Hardness = 3.5,—4.0. Sp. gr. = 3.9,—4.0.

1. Prismatic.

Prism unknown. Cleavage prismatic, but very imperfect.

Genus ii.

Genus ii.—ZINC-BLENDE. *Blende.*

Many axes. Cleavage tessular. Streak brown and white.
Hardness 3.5,—4.0. Sp. gr. = 4.0,—4.2.

1. Dodecahedral.

Tessular. Cleavage dodecahedral.

Genus iii.—ANTIMONY-BLENDE. *Red Antimony.*

Three axes. Cleavage prismatic. Streak red. Hardness
= 1.0,—1.5. Sp. gr. = 4.5,—4.6.

1. Prismatic.

Prism unknown. Cleavage prismatic.

Genus iv.—RUBY-BLENDE.

One axis. Cleavage rhomboidal. Streak reddish. Hard-
ness = 2.0,—2.5. Sp. gr. 5.6,—8.2.

1. Rhomboidal. *Red Silver.*

Rhomboid = $109^{\circ} 28'$. Cleavage rhomboidal. Hardness
= 2.5. Sp. gr. 5.6,—5.7.

2. Prismato-rhomboidal. *Cinnabar.*

Rhomboid = Cleavage in the direction of the
sides of the six-sided prism. Hardness = 2.0,—2.5. Sp. gr.
= 6.7,—8.2.

Genus v.—SULPHUR.

Three axes. Cleavage prismatic. Streak yellow and white.
Hardness = 1.5,—2.1. Sp. gr. = 2.3?—3.6.

Order VI.—SULPHUR.

Genus i.—SULPHUR.

Three axes. Cleavage prismatic. Streak yellow; white.
Hardness = 1.0,—2.5. Sp. gr. = 1.9,—3.6.

1. Red Orpiment or Hemi-prismatic Sulphur.

Prism $107^{\circ} 42'$. Cleavage in the direction of the diagonals
of the prism, but imperfect. Hardness = 1.0,—2.0. Sp. gr.
= 3.3,—3.4.

2. Yellow

2. Yellow Orpiment or Prismatic Sulphur.

Prism unknown. Cleavage prismatic. Hardness = 1.5, 2.0. Sp. gr. = 3.4,—3.6.

3. Prismatic Sulphur.

Prism $107^{\circ} 19'$; $84^{\circ} 24'$; Basis = $102^{\circ} 41'$. Cleavage prismatic and axifrangible. Hardness = 1.5,—2.5. Sp. gr. = 1.9,—2.1.

CLASS IV.—INFLAMMABLE MINERALS.

Order I.—RESIN.

Genus i.—HONEYSTONE.

One axis. Cleavage pyramidal, Hardness = 2.2,—2.5. Sp. gr. = 1.4,—1.6.

1. Pyramidal.

Pyramid = $118^{\circ} 4'$; $93^{\circ} 22'$. Cleavage pyramidal.

Genus ii.—MINERAL RESIN.

Without form. Hardness = 0,—2.2. Sp. gr. = 0.8,—1.2.

1. Yellow Mineral Resin or Amber.

Solid. Yellow and white. Streak white. Hardness = 2.0, 2.2. Sp. gr. = 1.0.—1.1.

2. Black Mineral Resin. *Naphtha, Petroleum, Mineral Pitch, &c.*

Solid and fluid. Black; brown; red; green. Streak black; brown; yellow; green. Hardness 0.—2.0. Sp. gr. = 0.8,—1.2.

Order II.—COAL.

Genus i.—COAL.

Amorphous. Black; brown. Hardness = 1.0,—2.5. Sp. gr. = 1.2,—1.5.

XXXX CHARACTERISTIC OR TABULAR VIEW, &c.

1. Brown Coal.

Brown. Low resinous lustre. Bituminous smell. Hardness = 0.—1.0. Sp. gr. = 1.0,—1.3.

2. Black Coal.

Black. Higher resinous lustre. Hardness = 2.0,—2.5. Sp. gr. = 1.2,—1.4.

3. Glance-Coal.

Black. Partly imperfect metallic lustre. No bituminous smell. Hardness = 2.0,—2.5. Sp. gr. = 1.3.

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MINERAL

MINERAL SYSTEM

CLASS I.

EARTHY MINERALS.

ORDER I. GEM.

GENUS I. DIAMOND.

THIS Genus contains but one species, viz. Octahedral or Common Diamond.

1. Octahedral or Common Diamond.

Demant, *Werner*.

Octaedrischer Demant, *Mohs*.

Adamas, *Plinius*, Hist. Nat. l. xxxvii. c. 4.—Alumen lapidosum pellucidissimum hyalinum, *Lin.*—Gemma vera colore aqueo, *Cartheus*.—Diamant, *Romé de Lisle*, t. ii. p. 189.—Quartsum nobile, *Born*, t. i. p. 56.—Diamond, *Kirw.* vol. i. p. 393.—Diamant, *Estner*, b. ii. s. 54. *Id. Emm.* b. i. s. 187.—Le Diamant, *Broch*, t. i. p. 153. *Id. Haüy*, t. iii. p. 287.—Diamant, *Reuss*, b. iii. s. 198. *Id. Lud.* b. i. s. 57. *Id. Suck.* 1^r th. s. 80, 85. *Id. Bertele*, s. 333, 335. *Id. Mohs*, b. i. s. 3, 16. *Id. Haberk.* s. 161. *Id. Lucas*, p. 91. *Id. Brong.* t. ii. Vol. I. A p. 58.

58.—Diamant, *Brard*, p. 205. *Id.* *Steffens*, b. i. s. 8.—Diamond, *Kud*, vol. ii. p. 31.—La Diamant, *Hauy*, Tabl. p. 69.—Demant, *Haff*, b. i. s. 358. *Id.* *Haus. Handb.* b. i. s. 58.—Diamond, *Aikin*, p. 58.

External Characters.

THE most common colours of the Diamond are white and grey. The varieties of white are, snow-white, greyish-white, and yellowish-white; of grey, ash-grey, smoke-grey, bluish-grey, pearl-grey, yellowish and greenish grey.

Besides these two colours, it occurs blue, red, brown, yellow, and green.

Of blue, the only variety is indigo-blue, which appears to pass into red.

Of red, the varieties are rose-red and cherry-red; from the latter it passes into a brown and yellowish-brown; from this into ochre-yellow, orange-yellow, wine-yellow, lemon and sulphur-yellow; further, into siskin-green, asparagus-green, pistachio-green, black-green, and, lastly, into mountain-green: which latter passes into greenish-grey, and greenish-white.

The clove-brown passes into blackish-brown, pitch-black, and greyish-black.

Of all the colours, blue and black are the rarest.

The colours are generally pale and light, seldom deep, and very seldom dark. It exhibits a most beautiful play of colours, in the direct rays of the sun, or in candle-light, particularly when cut.

It occurs in rolled pieces, in indeterminate angular and spherical grains; also crystallized in the following figures:

1. Regular octahedron, in which each plane of the crystal is inclined on the adjacent, under $109^{\circ} 28' 10''$. The faces are either straight or convex, and of these varieties

varieties the convex or curvilinear are the most frequent*. This is the fundamental figure, or that from which all the others may be derived. It is represented in Fig. 1. Pl. I. When the planes of the octahedron become alternately smaller and larger, it passes into

2. A simple three-sided pyramid, which is truncated on all the angles. Sometimes the apex is very deeply truncated, and then there remains only
3. A segment of the octahedron. Sometimes two of these segments are joined by their basis, and form a
4. Twin-crystal.

*Other varieties of form arise from the octahedron, by alterations of its edges.

5. Octahedron, in which the edges are truncated. The truncating planes are cylindrical convex †.

6. The octahedron, flat bevelled on all the edges. The bevelling planes are also convex.

7. The octahedron, bevelled on all the edges, and the bevelling planes once broken.

When the truncating planes of the variety 5. become so large that they meet, and the original planes of the octahedron disappear, there is formed a

8. Rhomboidal dodecahedron, with cylindrical convex faces, which is sometimes very short, sometimes much elongated ‡.

* Diamant primitif, Hally. — *Essai de Lisle*, t. II. p. 191. Pl. 3. fig. 1.

† Diamant plan-convex, Hally. — *Essai de Lisle*, t. II. p. 195. var. 1. Pl. 3.

‡ Diamant sphéroïdal, concave, Hally. — *Essai de Lisle*, p. 199. var. 4. Pl. 3. fig. 7.

When the bevelling planes of variety 6. become so large that the original planes disappear, there is formed

9. An octahedron, with convex faces, in which each is divided into three triangular ones. The dividing edges run from the middle point of each face to the angles. The crystal has thus 24 equal convex triangular faces*.

When the broken bevelling planes of the variety 7. become so large that they meet, and the original faces of the octahedron disappear, there is formed an

10. Octahedron, with convex faces, and in which each is divided into six faces or planes. In this figure, the dividing edges run from the center of each face; three to the angles, and three to the middle of the edges†. The crystal consists of 48 equal curved faces, and has a rounded appearance, Fig. 2. Pl. I.

The rhomboidal dodecahedron, var. 8. affords the following varieties of form:

11. Rhomboidal dodecahedron, with diagonally broken planes, and all the planes broken or divided in the direction of the smaller diagonal‡.

When the prism of the dodecahedron becomes lower, and the acuminations on both ends meet, there originates

12. A

* Romé de Lisle, p. 196. var. 2. Pl. 3. fig. 17.

† Diamant spheroidal sextuplé, Haüy.—Romé de Lisle, p. 197. var. 3. Pl. 3. fig. 18.

‡ Romé de Lisle, p. 200. var. 5. Pl. 4. fig. 66.

12. A flat double three-sided pyramid, in which the lateral planes of the one are set on the lateral planes of the other, and the edge of the common basis sometimes truncated.

Lastly, if we conceive two rhomboidal dodecahedrons pushed into each other in the direction of their length to such an extent, that the lateral planes almost entirely disappear, and that scarcely more than the acuminations remain, and further, that one prism; in regard to the other, is turned round $\frac{1}{3}$ th of its circumference, so that the acuminate planes of the one dodecahedron rest upon those of the other,—another twin-crystal is formed, which may be thus described :

13. Very flat double three-sided pyramid, with cylindrical convex faces, the lateral faces of the one set on the lateral faces of the other, and each angle of the common basis flatly acuminate with four planes, which are set obliquely on the planes of the two pyramids. These acuminate planes are the remains of the lateral planes of the dodecahedrons.

If the planes of the dodecahedrons are divided, there is formed a

14. Very flat double six-sided pyramid.

15. Cube, truncated on the edges.

The crystals are generally very small, seldom small, and very rarely middle-sized. Those of a greater magnitude are uncommonly rare.

The crystals are all around crystallised.

The surface of the grains is either rough, granulated, or uneven; that of the octahedrons generally smooth; in the dodecahedron, and the other forms which originate from the truncation and bevelment of the edges of the octahedron,

tahedron, the surface is rough or streaked; and that of the twin-crystal var. 13. is granulated.

Externally, the smooth surface of the crystals is splendid; of the streaked, shining; and of the rough and granulated, glimmering*.

Internally, it is always splendid, often specular splendid, and the lustre is perfectly adamantine.

The cleavage is octahedral, or parallel with the sides of an octahedron.

It is generally straight foliated, sometimes floriform foliated.

The fragments are octahedral or tetrahedral.

It rarely occurs in distinct concretions; and these are small, and fine granular.

It is seldom completely transparent; more generally it rather inclines to semitransparent; but the black variety is nearly opaque.

It refracts single.

It scratches all other known minerals.

It is rather easily frangible.

It affords a grey streak.

Specific gravity, 3.518, *Cronstedt*.—3.521, *Muschenbroeck*.—3.521, *Wallerius*.—3.500, *Brisson*.—3.600, *Werner*.—3.5185 to 3.55, *Haüy*.—3.51 to 3.53, *Brongniart*.—3.488, *Lowry*.—3.4, 3.6, *Mohs*.

Constituent Parts.

Boetius de Boot, in his *History of Gems*, published in 1609, conjectured that the diamond was an inflammable substance. In 1673, Boyle discovered, that when exposed to

* It is remarked, that the greater number of diamonds with curved faces, have a dull surface.

to a high temperature, part of it was dissipated in acrid vapours. In 1694 and 1695, experiments were made in the presence of the Grand Duke of Tuscany, which confirmed those of Mr Boyle, and shewed that the diamond, although the hardest of minerals, agrees with combustible bodies, in being combustible. In 1704, Sir Isaac Newton, in his great work on Optics, hinted, that from its very great refracting power, it might be an unctuous substance coagulated*.

Since that period, the diamond has been very often examined by chemists, and they find, that when heated to the temperature of 14° of Wedgwood's pyrometer, or not so high as the melting point of silver, it gradually dissipates and burns, and combines with nearly the same quantity of oxygen, and forms the same proportion of carbonic acid, as charcoal. Hence it consists principally of carbon.

Physical Characters.

When rubbed, whether rough or polished, it shews positive electricity; whereas quartz, and the other precious stones, if rough, afford negative electricity, but when polished, positive electricity. In general, it does not retain this electricity above half an hour. It becomes phosphorescent when exposed to the rays of the sun. Many diamonds, however, do not become phosphorescent, although agreeing in colour, form, and transparency, with those which readily become luminous. The continuance of the phosphorescence varies from five or six seconds to a full hour, and this even when the stone has not been

* Newton does not appear to have been acquainted with the experiments made in Tuscany: and, besides, a considerable part of his work on Optics was written in 1675.

been exposed more than a few seconds to the rays of the sun. It is phosphorescent under water as well as in the air. The phosphoreal light is shining and firey, not shining white like that exhibited by calcareous-spar. Diamond exposed to the blue rays of the prism, remains phosphorescent for fifteen minutes; but when exposed to the red rays, is not phosphorescent. The spark from a charged jar produced the same effect as exposure to the sun's rays. Exposure to the light of a wax-candle also produced phosphorescence; but the light even of the full moon occasioned no phosphorescence. The remarkable facts in regard to the phosphorescence of the diamond, are then as follows: 1. The striking phosphorescent property of some, and the total want of it in other diamonds. 2. The efficacy of the blue rays, and the inefficacy of the red rays. 3. The perfect agreement in external aspect of phosphoric and non-phosphoric diamonds. It is remarked by Grossier, that sometimes a diamond which does not become phosphorescent by the simple action of the solar rays, may be made so, by previously immersing it for some time in melted borax.—*Grossier, Journ. de Physique, vol. xx. p. 270.*

Since the time of Sir Isaac Newton, the diamond has been supposed to exceed every other body in its power of refracting and reflecting light, the index of refraction, according to that philosopher, being about 2.439. Dr Brewster, however, has found, that both red lead-ore and orpiment exceed the diamond in their action upon light. Owing to the great quantity of light which it reflects at both surfaces, the diamond is never completely transparent; and in consequence of its high refractive power, it reflects all the light that is incident upon its posterior surface at an angle of incidence exceeding $24^{\circ} 13'$, from which cause it derives that high lustre to which it owes its value as an ornament. The diamond has always been considered as a
crystal

crystal which gives single refraction; and in whatever way the diamond is cut, it exhibits no direct marks of two images. Dr Brewster, however, has found, that it possesses the property of depolarising light; and it necessarily follows, from his theory of depolarisation, that like many other bodies, it actually forms two images, which are polarised in an opposite manner, like those of all doubly refracting crystals; but in consequence of its possessing only one refracting power, these images can never be separated and rendered visible. The diamond polarises light by reflection at an angle of $68^{\circ} 10'$ according to experiment, and at angles of $68^{\circ} 2'$ according to theory; and its dispersive power is 0.038, nearly the same as oil of olives, and very much below flint glass.

Geognostic Situation.

It occurs in imbedded grains and crystals, in a sandstone named in Brazil *cascalho*, which rests on chlorite and clay-slate. The sandstone often contains grains of gold, and has occasionally a ferruginous basis. In some districts in India, in mining for this gem, they first pass through a bed of hornstone (claystone?), containing balls of hornstone and jasper; next through a ferruginous sandstone, which leads to the *diamond bed*, or rock, containing grains and crystals of diamond, and which appears to be a secondary or floetz-trap rock. In other places, immediately below the soil, are beds of red or bluish-black clay, underneath which is the *diamond bed*, consisting of clay with rolled masses of different kinds; and, lastly, many undoubted alluvial tracts in Brazil and India are celebrated for the diamonds they afford. In Brazil, the gravel consists principally of quartz, mixed with oxide of iron, and containing, besides the diamonds, blue, yellow, and white topazes, and grains of gold.

Geographic

Geographic Situation.

Asia.—The diamond was first found in this quarter of the globe, and is still collected there, although not in such quantity as formerly. It occurs in the central and southern parts of India: the peninsula of Malacca, and the island of Borneo.

America.—Diamonds were first found in America in the district of Cerro do Frio in Brazil, towards the beginning of the last century.

Lord Anson, who performed his voyage round the world in the years 1740–1–2–3 and 4, gives the following account of its first discovery: “I have already mentioned, that besides gold, this country does likewise produce diamonds. The discovery of these valuable stones is much more recent than that of gold, it being as yet scarce twenty years since the first were brought to Europe. They are found in the same manner as the gold, in the gullies of torrents, and beds of rivers; but only in particular places, and not so universally spread through the country. They were often found in washing the gold, before they were known to be diamonds, and were consequently thrown away with the sand and gravel separated from it. And it is very well remembered, that numbers of very large stones, which would have made the fortunes of the possessors, have passed unregarded through the hands of those, who now with impatience support the mortifying reflection. However, about twenty years since, a person acquainted with the appearance of rough diamonds, conceived that these pebbles, as they were then esteemed, were of the same kind: But it is said, that there was a considerable interval between the first starting this opinion, and the confirmation of it by proper trials and examination,

tion,

tion, it proving difficult to persuade the inhabitants, that what they had been long accustomed to despise, could be of the importance represented by this discovery; and I have been informed, that in this interval, the governor of one of these places procured a good number of these stones, which he pretended to make use of at cards, to mark with instead of counters. But it was at last confirmed by skillful jewellers in Europe, consulted on this occasion, that the stones thus found in Brazil were truly diamonds, many of which were not inferior, either in lustre or any other quality, to those of the East Indies *."

But Cerro do Frio is not the only district in Brazil where this gem is found; it is also collected in the provinces of Goyaz, Matto Grosso, and Saint Paul.

Diamond Mines.

Brazil.—In Brazil, the usual method of searching for diamonds, is to collect the disintegrated sandstone met with at the bottoms of rivers and of ravines, and, by washing, to separate the clayey matter from the grains of quartz and diamond. The residue is carefully examined for the diamonds it may contain, which are distinguished by their adamantine lustre, and regular forms †.

Hindustan.—In the district of *Cuddapah*, the mode of working the diamond mine is as follows. After all the superincumbent beds, and the large stones in the diamond bed, are removed out of the mine, the small gravel and other constituents of the bed are carried

* Anson's Voyages, 4to, p. 51.

† Mineralogische nachrichten aus Brazillen mitgetheilt von dem H. Ingenieur-Oberstleutenant von Eschwege.—Von Moll's Neue Jahrbucher der Berg und Hüttenkunde, 5ter Band, 3te Lief, s. 321, &c.—Mawe's Treatise on Diamonds,

ried to a small distance, and put into a cistern, about eight feet square, and three deep. In this situation, water is poured upon it, which separates the lighter loamy particles. The gravel and small stones which sink to the bottom, are then thrown into a heap beside the cistern, from which they are conveyed to a smooth plane of about twenty feet square, made of hardened clay. Upon this the whole is thinly spread. The gravel in this position being slightly moistened, six or seven people go over it several times in succession. The first time, they pick out only the large stones; the second and subsequent times, the smaller gravel is carefully turned over with the flat of the hand, whilst they as carefully watch for the spark from the diamond, which invariably strikes the eye.

At *Banaganpilly*, the Diamond Mines, as they are called, are scarcely any thing but deep holes, open at top; sometimes, indeed, the work is carried on for some extent under the rock, which is then supported by stone pillars. None are deeper than twenty feet. The gallery under the rock is so low, that the people are obliged to work in it sitting, a mode of working which an Indian prefers to every other. The solid rock of the hills, (which by the bye is not destitute of diamonds), is an aggregate consisting chiefly of a coarse grey hornstone, with rounded pebbles of the same species, or of jasper. At some depth this rock becomes a ferruginous sandstone, the grains of which are finely cemented together. Through this solid rock they are obliged to make their way before they arrive at the bed in which the diamonds are usually found. They commence at different places, as their fancy leads them, with a spot about twenty feet square, which by iron instruments and steel wedges, they break into slabs and fragments of from one hundred to five hundred pounds weight. In this way they sink to the
diamond

diamond bed, which is fifteen or twenty feet under the surface; this bed extends round the whole hill, and is as regular in its thickness and extent as the other unproductive beds in the same place: it consists of a conglomerate, composed of rounded siliceous pebbles, quartz, calcedony, and jasper. The cement appears to be of the nature of clay or wacke, and is small in quantity: thus it appears that the diamond bed is of the same nature with the rocks both above and below it, but it is distinguished from them by its superior hardness. This bed is seldom more than a foot in thickness; and is intimately connected with the beds both above and below it, and frequently differs from them in nothing but the greater quantity of pebbles which it contains.

It appears from this description, that the diamond bed here is a solid rock, whereas at Cuddapah and other places it is in a state of gravel.

The mass containing the supposed diamonds is carefully cleared from the portions of the roof, and floor of the mine, that may be adhering to it: it is then carried to another spot of ground, where it is broken into pieces, and gradually reduced by means of iron instruments to the size of very small gravel. The process followed for separating the diamonds from the rubbish is almost the same as that observed in other places.

At *Ovalumpilly* the diamond bed is found under a bed of red clay, about three feet thick

Uses.

* The above descriptions are from *Heyne's Tracts on India*, a work which contains an account of the Diamond Mines in the Peninsula of India.—*Mawe's Treatise on Diamonds* may be consulted for information in regard to the diamond mines in Brazil.

Uses.

The diamond, on account of the splendour of its lustre, its peculiar play of colour, its hardness, and lastly, its rarity, is considered as the most precious substance in the mineral kingdom, and is particularly valued by jewellers. The diamonds purchased by jewellers are generally in grains or crystals, and sometimes coarsely polished.

It is also used by lapidaries for cutting and engraving upon harder gems; by watchmakers in their finer kinds of work; and by glaziers for cutting glass. The diamonds chosen for cutting glass are all crystallized. The faces are curved, and hence the meeting of any two of them presents a curvilinear edge. If the diamond be so placed that the line of the intended cut is a tangent to this edge near its extremity, and if the two surfaces of the diamond, laterally adjacent, be equally inclined to the surface of the glass, then the conditions necessary for effecting the cut are complied with. A simple fissure is effected, which need not be more than $\frac{1}{200}$ th of an inch in depth. When a force is applied to one end of this fissure, a crack extends itself almost certainly in the direction of the fissure. Dr Wollaston, to whom we are indebted for the preceding observations, found that other bodies, as sapphire and spinel, when ground into the same curved surfaces as the diamond, would also cut glass; but the edges very speedily lost the requisite shape*.

1. *Art*

* Wollaston, *Philosophical Transactions of the Royal Society of London* for 1816.

1. *Art of Cutting and Polishing Diamonds.*

The ancients were unacquainted with the art of cutting the diamond, and hence they used it in its natural granular or crystallised state *. Even in the middle ages, this art still remained unknown; for the four large diamonds that ornament the clasp of the imperial mantle of CHARLEMAGNE, and which is still preserved in Paris, are uncut octahedral crystals.

The art of cutting and polishing diamonds was probably known to the artists of Hindostan and China at a very early period. European artists, until the fifteenth century, were of opinion that it was impossible to cut the diamond. Robert de Berghen relates, that Louis Berghen, a native of Bruges, in the year 1456, endeavoured to polish two diamonds, by rubbing them against each other: he found that by this means a facet was produced on the surface of the diamonds; and in consequence of this hint, constructed a polishing wheel, on which, by means of diamond powder, he was enabled to cut and polish this substance, in the same way as other gems are wrought by emery. James of Trezzo appears to have been one of the first artists who cut figures on the diamond itself. Clement of Biragues, in the year 1564, cut figures on the diamond; and even so early as the year 1500, Charadossa cut the figure of one of the Fathers of the Church on a diamond for Pope Julius II. The artists

* Some antiquaries pretend, that the ancients cut figures on the diamond itself. Govi, for example, cites an antique head of this kind, in the possession of the Duke of Bedford. Lessing, a very acute and skilful antiquary, is of opinion, that these pretended antique cut diamonds are amethysts or sapphires.

tists Natter and Costanzi were also famous for cutting figures on the diamond.

This art has been gradually improved, particularly by the Dutch and British jewellers. For a long time all the finest diamonds were sent to Holland to be cut and polished, owing to the real or fancied superiority of the Dutch artists. Now the diamond cutters in London are considered as equal to any in the world; and we no longer hear of this gem being sent abroad to be cut by foreign artists, on account of any want of skill in our workmen.

The cutting and polishing of the diamond is effected in the following manner: If the rough diamond has rents or flaws which must be removed, or if the figure is such that it must be altered before it is regularly cut, we either split or saw off the part or parts. The splitting is effected by the blow of a hammer on a small chissel, placed in the direction of the folia or cleavage of the diamond. The sawing is effected by means of an iron wire attached to a bow; the wire is covered with diamond powder, and drawn backwards and forwards, until the portion is cut off. This, however, is a very tedious process, as the wire is generally cut through after having been drawn across the diamond five or six times, and thus requires very frequent renewal. When the diamond is in this way freed from its flaws, and reduced to the proper shape, it is next imbedded in a strong cement of brick-dust and white pitch, fixed at the end of a spindle-shaped stick about a foot long, with that portion only projecting, the removal of which is to form the facet. The facet is formed by the friction of another diamond fixed in a stick in a similar manner to the former, with one of the angles projecting. In order to collect the powder and splinters that are detached during the process, the cutting is performed over a strong box, four or five inches

inches square, furnished with a false bottom, perforated with excessively minute holes, in order to sift as it were the dust from the splinters; and also with two upright iron pegs fixed on the sides for the workmen to support and steady his fingers against, while, with a sharp repeated stroke, somewhat between scratching and cutting, he is wearing away the diamond on that part where the facet is to be made. This being done, the cement is softened by warming it, and the position of the diamond is changed, in order to bring a fresh part under the action of the cutting diamond. When, in this manner, all the facets have been cut upon the surface of the diamond, the cutting is completed. The next object is to polish the facets, and, at the same time, to remove any little inequalities that may have taken place in the cutting. The polishing mill is very simple. It consists of a circular horizontal plate of cast iron, 14 or 15 inches in diameter, (called a *skive*), suspended on a spindle, and put in motion by means of a wheel 5 or 6 feet in diameter, and turned by an assistant. From the centre to the circumference of the iron plate, are shallow grooves, formed by rubbing it in that direction with a fine-grained sandstone; these grooves serve to retain the mixture of oil and diamond-powder with which the plate is charged. In order to keep the diamond perfectly steady while the polishing of each facet is going on, the following contrivance is had recourse to. A copper cup, about three quarters of an inch in depth and width, and furnished with a stem about four inches long of thick copper wire, is filled with plumbers' solder, which also projects in a conical form beyond the rim of the cup; in the apex of this cone, the solder being softened by heat, the diamond is imbedded with one of the facets projecting. The stem of the cup is now put into very powerful pin-

cers, which screw up with a nut and a wrench, and thus hold it perfectly tight. The handles of the pincers are of wood, are broad, and terminated by two feet about an inch high. In this position the diamond is placed on the plate, the pincers resting on their legs on the wooden bench or table that supports the plate, and pressing at the same time against an upright iron peg; the broad part of the pincers between the legs and the diamond is then loaded with weights, both to steady the machine and to increase the pressure of the diamond against the skive. A little oil and diamond-powder is now dropped on the plate; it is set in motion at the rate of about 200 revolutions in a minute, and the grinding and polishing processes now begin. The diamond is examined from time to time, and is adjusted so as to give the facet its true form. The heat occasioned by the friction is at all times considerable, and sometimes increases to such a degree as to soften the solder, and displace the diamond. This accident sometimes occasions a flaw in the diamond, and always damages the skive, by tearing up its surface. There is room in the skive for three or four diamonds, and a skilful operator can undertake the polishing of all of them at the same time. The completion of a single facet often occupies some hours.

2. *Different forms into which the Diamond is cut.*

Diamonds are cut and manufactured by jewellers into brilliant, rose, and table diamonds. To fashion a rough diamond into a brilliant, the first step is to modify the faces of the original octahedron, so that the plane formed by the junction of the two pyramids shall be an exact square, and the axis of the crystal precisely twice the length of one of the sides of the square. The octahedron being thus rectified, a section is to be made parallel to the common base,

or

or girdle, so as to cut off $\frac{5}{8}$ ths of the whole height from the upper pyramid, and $\frac{1}{8}$ th from the lower. The superior and larger plane thus produced is called the *table*, and the inferior and smaller one is named the *collet*; in this state it is called a *complete square table diamond*. To convert it into a brilliant, two triangular facets are placed on each side of the table, thus changing it from a square into an octagon; a lozenge-shaped facet is also placed at each of the four corners of the table, and another lozenge extending lengthwise along the whole of each side of the original square of the table, which, with two triangular facets, set on the base of each lozenge, complete the whole number of facets on the table side of the diamond, viz. eight lozenges, and twenty-four triangles. On the collet side are formed four irregular pentagons, alternating with as many irregular lozenges, radiating from the collet as a centre, and bordered by sixteen triangular facets adjoining to the girdle. The brilliant being thus completed, is set with the table side upwards, and the collet side implanted in the cavity made to receive the diamond. Such is the method recommended by Mr Jeffries for cutting the brilliant diamond, and which ought to be attended to, if we are desirous that the diamond should display its highest degree of lustre and play of colour; but Mr Mawe remarks, "that so great a stress is laid by modern fashion on the superficial extent of a brilliant, that the rules just given are not much attended to; and, in forming the facets, artists trust principally to an accurate and well practised eye*."

The *regular rose diamond* is that form given to those stones, the spread of which is too great in proportion to their depth, to admit of being brilliant cut, without a great

loss of substance. It is formed by inscribing a regular octagon in the centre of the table side of the stone, and bordering it by eight right-angled triangles, the bases of which correspond with the sides of the octagon; beyond these is a chain of eight trapeziums, and another of sixteen triangles. The collet side also consists of a minute central octagon, from every angle of which proceeds a ray to the edge of the girdle, forming the whole surface into eight trapeziums, each of which is again subdivided by a salient angle (the apex of which touches the girdle,) into one irregular pentagon, and two triangles*.

The *table diamond* is the least beautiful mode of cutting, and is used only for those stones, or rather fragments, which, with a considerable breadth, have only a very trifling depth.

3. Valuing Diamonds.

In valuing diamonds, we have to attend to their *weight*, their *form* when cut, *colour*, *transparency*, *purity*, or *freedom from flaws, veins and stains*, the *regularity of the cleavage*, *proportion of the parts*; and, lastly, the *setting on of the facets*.

a. *Weight and Form*.—In the cutting either of a brilliant or a rose diamond, of regular proportions, so much is cut away, that the weight of the polished gem is not more than half that of the rough crystal out of which it was formed; whence the value of a cut diamond is esteemed equal to that of a similar rough diamond of twice its weight, exclusive of the price of workmanship. The weight and consequently the value, of diamonds, is estimated in *carats*, one of which is equal to four grains, and the difference

* The finest rose cut diamonds were formerly manufactured in Holland. More than 300 years ago, this mode of cutting was known and practised at Antwerp.

difference between the price of the one diamond and another, *ceteris paribus*, is as the square of the respective weights. Thus the value of three diamonds, of one, two, and three carats weight, is as one, four and nine. The average price of rough diamonds that are worth working, is about L. 2 for the first carat; and consequently in wrought diamonds, exclusive of the cost of workmanship, the cost of the first carat is L. 8. In other words, in order to ascertain the value of a wrought diamond, ascertain its weight in carats, and fractions of a carat, multiply this by two, then multiply this product into itself, and finally multiply this latter sum by L. 2. Hence a wrought diamond of

1 carat is worth	-	-	£ 8
2 carats.....	-	-	32
3	-	-	72
4	-	-	128
5	-	-	200
6	-	-	288
7	-	-	392
8	-	-	512
9	-	-	612
10	-	-	800
20	-	-	3,200
30	-	-	7,200
40	-	-	12,000
50	-	-	20,000
60	-	-	28,800
70	-	-	39,200
80	-	-	51,200
90	-	-	64,800
100	-	-	80,000

This rule, however, actually holds good only in the ~~small-~~ diamonds of 20 carats and under; the larger ones, in consequence of the scarcity of purchasers, being disposed of at prices greatly inferior to their estimated worth. The value of some of the most perfect diamonds exceeds that given in the table; but for a stone that is flawed, cloudy, or of a bad colour, sometimes three quarters of the whole value may be deducted.

b. *Colour*.—The most frequent colours of the diamond, as already mentioned, are the white and grey, and of these the most highly prized by the jeweller is the snow white. The brown varieties are of inferior value, and the yellow diamond, which is not uncommon, is only esteemed of equal value with the snow white variety when the colour is deep and pure. The other varieties of colour occur but rarely, and are viewed as objects of curiosity to the collector rather than as generally interesting to the jeweller. Thus a rose diamond is more valuable than a snow white diamond of equal weight, owing to the great beauty of its colour, and its rarity; the green diamond is much esteemed on account of its colour, but the blue diamond is only prized for its rarity, as the colour is seldom pure. The black diamond, which is uncommonly rare, but destitute of beauty, is very highly prized by collectors*.

c. *Transparency*.—A good diamond must be nearly completely transparent. If semitransparent, it is of little value.

* Mr Milburn has the following observations on the colour of rough diamonds, which are deserving the attention of the diamond merchant. "The colour should be perfectly crystalline, resembling a drop of clear spring water, in the middle of which you will perceive a strong light, playing with

value. Transparency and purity comprehend what is called the *water* of the diamond by jewellers. If the gem is transparent and quite pure, it is said to be of the first water; if less transparent and pure, of the second, or of the third water.

d. *Freedom from flaws, veins and stains.*—Diamonds in a state of nature are sometimes rent in different directions; these rents are either confined to the surface or central parts of the stone, or traverse its whole mass. When the rents

a great deal of spirit. If the coat be smooth and bright, with a little tincture of green in it, it is not the worse, and seldom proves bad; but if there is a mixture of yellow with green, then beware of it,—it is a soft greasy stone, and will prove bad.

If the stone has a rough coat, so that you can hardly see through it, and the coat be white and look as if it were rough by art, and clear of flaws or veins, and no blemish cast in the body of the stone, (which may be discovered by holding it against the light), the stone will prove good.

It often happens, that a stone will appear of a reddish hue on the outward coat, not unlike the colour of rusty iron; yet by looking through it against the light, you may observe the heart of the stone to be white, (and if there be any black spots or flaws, or veins in it, they may be discovered by a true eye, although the coat of the stone be the same,) and such stones are generally good and clear.

If a diamond appears of a greenish bright coat, resembling a piece of green glass, inclining to black, it generally proves hard, and seldom bad; such stones have been known to have been of the first water, and seldom worse than the second; but if any tincture of yellow seem to be mixed with it, you may depend upon its being a very bad stone.

All stones of a milky coat, whether the coat be bright or dull, if never so little inclining to a bluish cast, are naturally soft, and in danger of being flawed in the cutting; and though they should have the good fortune to escape, yet they will prove dead and milky, and turn to no account.

All diamonds of a cinnamon colour are dubious; but if of a bright coat, mixed with a little green, then they are certainly bad, and are accounted amongst the worst of colours.

You will meet with a great many diamonds of a rough cinnamon coloured coat, opaque; this sort is generally very hard, and when cut, contains a great deal of life and spirit; but the colour is very unretain: it is sometimes white, sometimes brown, and sometimes of a fine yellow."

rents traverse the whole mass of the stone, or traverse its interior, the value of the diamond is diminished one half. If the rents are superficial, the value of the stone is not very greatly diminished. It requires a very experienced eye to distinguish these different kinds of rents.

Rough diamonds are frequently *beamy*, that is, look fair to the eye, yet are so full of veins to the centre that no art or labour can polish them. Mr Milburn, in his valuable work on *Oriental Commerce*, vol. ii. p. 80. gives the following account of *beamy* diamonds. "The veins run through several parts of the stone, and sometimes through all; and when they appear on the outside, they shew themselves like protuberant excrescences, from whence run innumerable small veins, obliquely crossing one another, and shooting into the body of the stone. The stone itself will have a bright and shining coat, and the veins will look like very small veins of polished steel rising upon the surface of the stone. This sort of stone will bear no polishing, and is scarcely worth a rupee per mangalin. Sometimes the knot of the veins will be in the centre, the fibres will shoot outward, and the small ends terminate in the coat of the diamond. This is more difficult to discover, and must be examined by a nice eye; yet you may be able here and there to observe a small protuberance, like the point of a needle, lifting up a part of the coat of the stone; and though by a great deal of labour it should be polished, it will be a great charge, and scarcely pay for the cutting, and is therefore to be esteemed as little better than the former. But if you are not very careful, they will throw one of these stones into a parcel, and oftentimes the largest."

A good diamond should never contain small spots of a white or grey colour of a nebulous form; it should be free of small reddish and brownish grains, that sometimes occur on their surface, or in their interior.

e. *Regularity*

e. *Regularity of the cleavage.*—A good diamond should split readily in the direction of the cleavage; it sometimes happens, however, that the folia are curved, as is the case in twin-crystals. When this is the case, the stone does not readily cut and polish, and is therefore of inferior value.

f. *Proportion of parts.*—In the cut and polished gem, the thickness must always bear a certain proportion to the breadth. It must not be too thin nor too thick; when too thin it loses much of its fire, and appears not unlike glass.

g. *The setting on of the facets.*—If these are not properly disposed, the diamond loses much of its fire, and its value is thereby diminished.

4. *Diamond Trade.*

The only diamond districts at present known, are those of India, Borneo, and Brazil. In the earlier ages, all the diamonds of commerce were obtained from India, but now the diamond mines of that country have become comparatively inconsiderable; several of them have been abandoned, and scarcely any of the rest contribute to the supply of the European market. Borneo furnishes annually a small quantity. The diamonds of the East are imported into Europe, in their rough state, in small parcels, called *bulsas*, neatly secured in linen, and sealed by the merchant, and are generally sold in Europe by the invoice, that is, are bought before they are opened, it being always found they contain the value for which they were sold in India, and the purchaser gives the importer such an advance on the invoice as the state of the market warrants. The bulse contains stones of various shapes and sizes. They may be imported duty free, saving the duty granted to the East India Company on diamonds imported from any place within the limits of their charter.

Brazil

Brazil affords more diamonds than India and Borneo, and it is said that nearly all the diamonds in the European market are obtained from that country. The diamond mines of Brazil belong either to the crown or to the Prince Regent. The trade in this gem, except through the medium of the government agents, is considered as contraband. Notwithstanding the severe penalties against this contraband trade, many diamonds are disposed of by private adventurers. The government diamonds, however, form the chief part of the trade. These are the produce of the different royal mines in the interior of Brazil; whence they are sent to the seat of government at Rio de Janeiro. The Prince Regent there selects from the whole such specimens as he chooses to add to his own magnificent collection, and the remainder are consigned to the Portuguese ambassador for the time resident in England, by whom they are deposited in the Bank for sale.

This branch of trade was, at one period, almost monopolized by the Dutch. The consul for Holland possessed an exclusive contract in Brazil for all the diamonds that were brought to the market in that country, whilst in India their agents were very active in securing all that were offered for sale. The trade is now divided between the English and Portuguese. The demand for diamonds of a moderate size is, at present, very great; and it would appear that the price of this gem has been gradually rising for several years. The sale of the larger diamonds has been very dull for many years past.

5. *Account of some large Diamonds.*

We shall conclude our history of the diamond, with a short account of some of the largest diamonds hitherto discovered.

a. Authors mention a diamond weighing 1680 carats, in the possession of the royal family of Portugal, which

was

was found in Brazil, and is still uncut. This gem, if valued according to the rule already mentioned, should be worth L. 5,644,870 Sterling. It is now, however, generally believed to be a fine white-coloured topaz.

b. One of the largest undoubted diamonds, is that mentioned by Tavernier, formerly in the possession of the Great Mogul, and which that traveller found to weigh $279\frac{9}{10}$ carats. It is the size of a hen's egg, of the same shape, and is cut in the rose form. Before cutting it weighed 900 carats. It was found in the mine of Colore, to the east of Golconda, about the year 1550.

c. A very large diamond is said to be in the possession of the Rajah of Mattan, in Borneo, in which island it was found about eighty years ago. It is egg-shaped, with an indented hollow near the smaller end. It is said to be of the finest water. It weighs 367 carats. Now, as 156 carats are equal to 1 ounce Troy, it is obvious that this diamond weighs 2 ounces 169.87 gr. Troy. Many years ago, the Governor of Borneo attempted to purchase this diamond. He sent a Mr Stewart to the Rajah, who offered 150,000 dollars, two large war-brigs, with their guns and ammunition, together with a certain number of great guns, and a quantity of powder and shot. The Rajah, however, refused to deprive his family of so valuable a hereditary possession, to which the Malays attach the miraculous power of curing all kinds of diseases, by means of the water in which it is dipped, and with which they imagine that the fortune of the family is connected.

d. The magnificent diamond on the top of the sceptre of the Emperor of Russia, deserves next to be noticed. It is perfectly pure; weighs 195 carats; and is the size of a pigeon's egg. It was one of the eyes of a Brahminical idol, and was stolen by a French grenadier, who disposed
of

of it at a very low price ; and, lastly, after passing through three other hands, it was offered for sale to the Empress Catharine of Russia, who purchased it for about L. 90,000 ready money, and an annuity of about L. 4000 more.

e. The diamond of the late Grand Duke of Tuscany, now in Vienna, is of a pale lemon-yellow colour, but beautifully formed, and weighs $139\frac{1}{2}$ carats.

f. The Pitt or Regent diamond. It is cut in the brilliant form, and is said to be the most beautiful diamond hitherto found. It weighs $136\frac{1}{4}$ carats, and was purchased for L. 130,000, although it is now valued at double that sum. It was brought from India by an English gentleman of the name of Pitt, and was sold by him to the Regent Duke of Orleans, by whom it was placed among the crown jewels of France. It is now set in the handle of the sword of state of the King of France.

g. The finest collections of crystallized diamonds in Europe are those in London, and of these the most complete are in the British Museum, and in the cabinets of Sir Abraham Hume and Mr Lowry. Mr Joseph Marryat *junior*, and two other collectors, possess diamonds of great value. On the Continent, the collection of Werner is the most perfect.

GENUS II.

GENUS II.—ZIRCON.

THIS genus contains but one species, viz. Pyramidal Zircon.

Pyramidal Zircon.

Pyramidaler Zircon, *Mohs*.

This species is divided into two subspecies, Common Zircon, and Hyacinth.

First Subspecies.

Common Zircon *.

Zirkon, *Werner*.

Topazius clarus hyalinus jargon, *Wall.* t. i. p. 252.—*Jargon* de Ceylan, *Romé de Lisle*, t. ii. p. 229. *Id.* *Born.* t. i. p. 77.—*Zirkon*, *Wid.* s. 233. *Id.* *Kirwan*, vol. i. p. 257. *Id.* *Estner*, b. ii. s. 35. *Id.* *Emm.* b. i. s. 3.—*Giargone*, *Nap.* p. 105.—*Zircon*, *Lam.* t. ii. p. 204. *Id.* *Broch.* t. i. p. 159. *Id.* *Haüy*, t. ii. p. 465.—*Gemeiner Zirkon*, *Reuss*, b. i. s. 56.—*Zircon*, *Lud.* b. i. s. 58. *Id.* *Suck.* 1r th. s. 166. *Id.* *Bert.* s. 304. *Id.* *Mohs*, b. i. s. 16. *Id.* *Lucas*, p. 89.—*Gemeiner Zircon*, *Hab.* s. 1.—*Zircon Jargon*, *Brong.* t. i. p. 269.—*Zircon*, *Kid.* vol. i. p. 125. *Id.* *Brard.* p. 106. *Id.* *Steffens*, b. i. s. 7.—*Zircon*, joints naturels peu sensibles; formes relatives à la variété prismée, *Haüy*, *Tabl.* p. 28.—*Zircon*, *Hoff.* b. i. s. 396. *Muschlecher Zircon*, *Haus.* *Handb.* b. ii. s. 618.—*Jargoon*, *Aikin*, p. 184.

External Characters.

The principal colour is grey: it also occurs white, green,
and

* The word *Zirkon*, is by some authors considered to be of Indian origin: others derive it from the French word *jargon*, which was applied to all those gems, which, on being cut and polished, had somewhat of the appearance of diamond.

and brown; and rarely yellow, blue, and red. White and brown are the extremes of its colour-suite, and the intermediate colours are grey, yellow, green, blue, and red. It never occurs hyacinth-red or orange-yellow.

The colours are generally pale, seldom dark, and often muddy.

It occurs in angular, or roundish original grains; and crystallized in the following figures:

1. Rectangular four-sided prism, rather flatly acuminated on the extremities with four planes, which are set on the lateral planes under equal angles*, fig. 3. This is the fundamental figure†.
2. The fundamental figure truncated on the lateral edges.
3. The fundamental figure bevelled on the angles between the acumination and the prism, and the bevelling planes set on the edges between the acumination and the prism‡, fig. 4. When these bevelling planes become larger, so that they meet and intersect each other, there is formed
4. A four-sided prism, acutely acuminated on the extremities by eight planes, of which two and two meet under very obtuse angles, and are set on the lateral planes of the prism. This acumination is frequently rather flatly acuminated by four planes,

* Zircon prismé, Haüy.

† The primitive form of Zircon, according to Haüy, is composed of two four-sided pyramids, applied base to base, whose sides are isosceles triangles. The inclination of the sides of the same pyramid to each other, is $124^{\circ} 12'$; the inclination of the sides of the one pyramid to those of another, $82^{\circ} 50'$; the angle of the summit is $73^{\circ} 44'$. Mohs states the two first at $123^{\circ} 19'$ and $81^{\circ} 20'$. Mr Phillips gives the same measurement.

Zircon plagiedre, Haüy.

planes, which are set on the obtuse edges of the first acumination.

5. N^o 3. in which the edges between the acumination and the prism are truncated *, fig. 5.

6. When the prism of N^o 1. disappears, there is formed a double four-sided pyramid.

The crystals are generally small and very small, seldom middle-sized, and occur loose or imbedded.

The surface of the crystals is sometimes rough, sometimes smooth, and that of the grains is uneven.

The surface of the grains is glistening, that of the crystals shining.

Internally it is splendid, passing into shining, and the lustre is intermediate between adamantine and resinous, but rather more inclined to the first.

The cleavage is fourfold, and the folia in the direction of the planes of a four-sided pyramid of $123^{\circ} 19'$ and $84^{\circ} 20'$. The cleavage is sometimes visible only in the direction of the extremities of a prism; but is not so perfect as in hyacinth.

The fracture is perfect and flat conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It alternates from transparent to opaque.

It refracts double in a high degree.

It is harder than quartz, but softer than topaz.

It is rather easily frangible.

Specific gravity, 4.557, to 4.721, *Lowry*.

Chemical

* Zircon soustractif, Haiiy.

Chemical Character.

It is infusible, without addition, before the blowpipe.

Constituent Parts.

	Zircon of Ceylon.	Zircon of Norway.
Zirconia, -	69.00	63
Silica, -	26.50	33
Oxide of Iron, -	0.50	1
	<hr/> 96.00	<hr/> 99
	<i>Klaproth, Beit. b. i.</i>	<i>Id. Klaproth,</i>
	<i>s. 222.</i>	<i>b. iii. s. 271.</i>

The Geognostic and Geographic Situations are the same with those of the second subspecies.

Observations.

1. This species is characterised by its colour-suite, the principal members of which are grey, green, and brown, generally of a muddy aspect; its suite of crystals, adamantine lustre, flat conchoidal fracture, considerable hardness, and weight.

2. It is distinguished from *Hyacinth* by colour, crystallization, kind of lustre, and perfect conchoidal fracture: from *Diamond*, by its crystallization, greater weight, inferior hardness, conchoidal fracture, and its grey muddy colours: from *Spinel*, by form, lustre, fracture, inferior hardness, and greater weight: from *Topaz*, by its crystallization, smooth lateral planes, kind of lustre, fracture, inferior hardness, and greater weight: from *Vesuvian*, by lustre, perfect acuminations, strong double refracting power, greater hardness and weight: from *Chrysolite*, by crystallization, lustre, greater hardness, and weight; and from

from all other cut and polished *gems*, by its exhibiting a stronger double refracting power.

Second Subspecies.

Hyacinth*.

Hiacinth, *Werner*.

Topazius flavo-rubens, *Hyacinthus*, *Wall.* t. i. p. 252.—*Hiacinth*, *Wid.* s. 254. *Id. Kirm.* vol. i. p. 257. *Id. Esner*, b. ii. s. 141. *Id. Emm.* b. i. s. 205.—*Giacinto*, *Nap.* p. 109.—*L'Hyacinthe*, *Broch.* t. i. p. 163.—*Hiacinth*, *Reuss*, b. i. s. 62. *Id. Lud.* b. i. s. 59. *Id. Suck.* 1r th. s. 172. *Id. Bert.* s. 308. *Id. Mohs*, b. i. s. 23. *Id. Hab.* s. 2.—*Zircon Hyacinthe*, *Brong.* t. i. p. 270.—*Hyacinth*, *Kid.* vol. i. p. 126. *Id. Steffens* b. i. s. 7.—*Hyacinth-joints naturels plus apparens; formes relatives à la variété dodécaèdre*, *Haüy*, *Tabl.* p. 29.—*Hiacinth*, *Hoff.* b. i. s. 407.—*Blättricher Zircon*, *Haus.* b. ii. s. 619.—*Hyacinth*, *Aikin*, p. 184.

External Characters.

The most frequent colours are red and brown, more rarely yellow, grey, and green; and the rarest is blue. The principal colour is hyacinth-red, which passes on the one side into orange-yellow; on the other into reddish-brown, brownish-red, and flesh-red.

It occurs sometimes in angular grains; more frequently crystallized, in the following figures:

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C

1. Rectangular

* The Hyacinth of the ancients appears to have been either amethyst or sapphire. The name hyacinth, is derived from that of the plant denominated *hyacinthus* by the ancients, which is supposed to be the *Hyacinthus orientalis* *Lin.*

1. Rectangular four-sided prism, acuminated on both extremities by four planes, which are set on the lateral edges, Fig. 6. Pl. I.
2. The preceding crystal, slightly truncated on the lateral edges, Fig. 7. Pl. I.
3. N° 2. in which the edges between the lateral and acuminating planes are also truncated, Fig. 8. Pl. I.

The crystals are small and very small, seldom middle-sized. They are all around crystallized.

The surface of the crystals is smooth and splendent.

Internally it is specular-splendent, and the lustre is intermediate between resinous and vitreous.

The cleavage is the same as in common zircon, but more perfect.

The fracture is perfect, and small conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It alternates from transparent to semitransparent.

It refracts double.

It has the same degree of hardness as common zircon.

It is rather easily frangible.

Specific gravity, 4.545, 4.620, *Klaproth*. 4.525, 4.780, *Mohs*.

Chemical Characters.

Before the blowpipe it loses its colour, but not its transparency, and is infusible without addition.

Constituent

[Subsp. 2. *Hyacinth*.*Constituent Parts.*

	Hyacinth of Ceylon.	Hyacinth of Expailly.	
Zirconia,	70.00	64.00	66.00
Silica,	25.00	32.00	31.00
Oxide of Iron,	0.50	2.00	2.00
Loss,	4.50	1.50	1.00
	<hr/> 100.00	<hr/> 100	<hr/> 100

Klaproth, Beit.
b. i. s. 231.

Vauquelin, Jour. d. Mines.
N. 26. p. 106.

Observations.

1. It is characterised by its colour-suite, the central colour of which is hyacinth-red, its crystallizations, resinous lustre, distinct cleavage, and great specific gravity.

2. It is distinguished from *Common Zircon* by its colours, crystallization, smooth planes, external and internal lustre, distinct cleavage, and small conchoidal fracture: from *Precious Garnet*, by its crystallization, resinous lustre, distinct cleavage, greater weight and infusibility.

3. Common zircon has been frequently confounded with Sapphire, Hyacinth, and several other minerals, as appears from the following enumeration. 1. The oriental hyacinth of Romé de Lisle (t. ii. p. 282.) is orange-coloured sapphire. 2. The occidental hyacinth is yellow-coloured topaz (Dutens, *Des pierres prec.* p. 62.) 3. Cruciform hyacinth is cross-stone. 4. Brown volcanic hyacinth is vesuvian. 5. White hyacinth of Somma is meionite. 6. Hyacinth of Compostella is iron-shot quartz. 7. Hyacinth of Dissentis (Saussure, *Voyages dans les Alpes*, n. 1902.) is a variety of garnet.

*Geognostic Situation of the Zircon Species, including
Common Zircon and Hyacinth.*

It occurs in grains and crystals, imbedded in gneiss and sienite; also imbedded in basalt and lava, and dispersed through alluvial soil, along with sapphire, spinel, ceylanite, pyrope, tourmaline, augite, olivine, iron-sand, iron-pyrites, and gold.

*Geographic Situation of the Zircon Species, including
Common Zircon and Hyacinth.*

Europe.—It occurs in this quarter of the globe, not only loose in the sand of rivers, but also in its original repository. Thus it is associated with sapphire and iron-sand, in what is called *volcanic sand*, in the rivulet of Rioupez-zouliou, near Expailly in Auvergne; and imbedded in basalt in the same country; also near to Pisa, and in the supposed volcanic sand of the Vicentine. In the vicinity of Trzibnitz and Podsedlitz in Bohemia, it occurs in a clayey alluvial deposit, near rocks of the newest trap formation, along with pyrope, sapphire, and iron; also, in very small grains, in *auniferous* sand, in Silesia; and in the trap rocks around Lisbon, and in those of Spain.

It was first found in its original repository at Friedrichschwärn, in the district of Christiania in Norway, where it occurs in considerable abundance in sienite. Faujas St Fond found it imbedded in basalt near Expailly; Cordier in a similar rock in the mountain of Anise, also in Auvergne; and Weiss detected it imbedded in a volcanic scoria in the same country. In the year 1812, I found it imbedded in a rolled mass of sienite in the shire of Gallogay.

Asia.

Asia.—In the island of Ceylon, where this mineral was first found, it occurs imbedded in gneiss along with sapphire, oriental ruby, and cinnamon-stone *; but is found most abundantly in the sand of rivers, along with spinel, sapphire, tourmaline, and iron-sand. It occurs in alluvial soil, in the district of Ellore in Hindostan; and it is mentioned by Reuss as a production of Asiatic Russia.

America.—A Spanish mineralogist, M. Henri Amara, presented Haiüy with some small crystals of zircon, which had been collected in the province of Antioquia, in the kingdom of Santa Fe de Bogota: it is mentioned as a mineral of Brazil; it occurs in granite, two miles from Baltimore in Maryland; in gneiss near Trenton in New Jersey; in granite in Schooley's Mountain in New York; in quartz at Sharon in Connecticut †; and Sir Charles Giesecké discovered it at Portusok in the island of Kittik-sut in South Greenland, imbedded in sienite, and associated with cerite.

Africa.—It is said to occur in Teneriffe.

Uses.

As common zircon is considered by jewellers one of the gems, it is frequently cut and polished, and used for ornamental purposes. The greyish-white and yellowish-white varieties are the most highly valued, on account of their resemblance to the diamond. The darker coloured varieties can be deprived of their colour by exposure to heat: hence artists generally employ this method, when they intend

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* This interesting discovery was made by Dr Davy, who is now actively employed in the investigation of the natural history of Ceylon.

† Cleaveland's Mineralogy, p. 206, 207.

tend to employ zircon in place of diamond. Like the diamond, it is cut into the table, rose and brilliant forms, and is used for jewelling watches, ear-pendants, necklaces, and, on account of the intermixture of grey in the colour, it is particularly valued in some countries as an ornament in mourning-dress. When cut, it exhibits in a faint degree the play of colours of the diamond; and hence it is not unfrequently sold as an inferior kind of diamond. The hyacinth is also esteemed by jewellers, and, when pure, and of considerable size, is employed in various kinds of ornamental work. But it seldom occurs large, and in trade, other minerals, as cinnamon-stone, hyacinth-coloured garnets, and rock-crystals, are frequently substituted for it.

GENUS III.—CORUNDUM*

THIS Genus contains three species, viz. Octahedral Corundum, Rhomboidal Corundum, and Prismatic Corundum.

1. Octahedral Corundum.

Octaëdrischer Corund, *Mohs*.

This species is subdivided into three subspecies, viz. Automalite, Ceylanite, and Spinel.

First

* *Corundum* is the Indian name for the coarser varieties of rhomboidal corundum: it was applied to the rhomboidal corundum by Count Bournon, and to the present genus by Mohs.

*First Subspecies.**Automalite* *.*Authomolite*, *Werner*.

Automalit, *Eckeberg*, in N. Allgem. Journal der Chemie, 5. B. s. 422,—45.—*Automalit*, Corindon zincifere, Jour. de Phys. an 14, p. 270.—*Automalit* & *Fahlunit*, *Karst.* Tabel. p. 102.—*Gahnite*, *Von Moll*.—*Spinelle* zincifere, *Haüy*, Tabl. p. 67.—*Automalith*, *Steffens*, b. i. s. 32. *Id. Hoff.* b. i. s. 526.—*Gahnit*, *Haus.* Handb. b. ii. s. 364. *Id. Aikin*, p. 185.

External Characters.

Its colour is muddy duck-green, which inclines very much to mountain-green.

It has been hitherto found only crystallized, and in the following figures :

1. Perfect octahedron.
2. Octahedron, with alternate larger and smaller planes.
3. Tetrahedron, truncated on the angles.
4. Segment of the tetrahedron.
5. Two segments, N^o 4. joined together, so that re-entering angles are formed on the three corners of the figure.

The crystals are small and middle-sized; all around crystallized, and the planes are smooth.

Externally it is glistening; and the lustre is pearly, inclining to semi-metallic. Internally it is shining on the principal fracture, but glistening on the cross fracture, and the lustre is resinous.

It has a fourfold cleavage, and the folia are parallel with the faces of an octahedron.

Fracture

* *Automalite* is derived from the Greek word *αὐτόματος*, and was given to this gem because it approaches to the metalliferous minerals by reason of its chemical composition, and thus deserts or denies its close affinity with the earthy minerals.

The fracture is flat conchoidal.

The fragments are splintery, or angular, and not very sharp-edged.

It is opaque, or faintly translucent on the edge.

It is so hard as to scratch quartz, but is scratched by spinel.

It is brittle.

It is rather easily frangible.

Specific gravity, 4.261, *Hisinger*. 4.297, *Hoffmann*. 4.696, *Hauy* *.

Chemical Character.

It is infusible before the blowpipe.

Constituent Parts.

Alumina,	-	60	-	-	42
Silica,	-	4	-	-	4
Oxide of Zinc,		24	-	-	28
Iron,	-	9	-	-	5
Sulphur,	-	0	-	-	17
Loss,	-	3	Undecomposed,		4
		<u>100</u>			<u>100</u>

Eckeberg, J. de Phys.
an 14, p. 270.

Vauquelin, Annales
du Mus. t. vi. p. 33.

Geognostic and Geographic Situations.

It occurs imbedded in talc-slate, along with galena, and has been hitherto found only at Fahlun in Sweden.

Observations.

In its crystallizations it resembles both Ceylanite and Spinel: it is distinguished from the former by its more distinct green colour, foliated fracture, inferior hardness, superior

* The automalite sometimes contains disseminated galena, which may be the cause of the high specific gravity in the specimens examined by Hauy.

[Subsp. 2. *Ceylanite*.

perior specific gravity, and chemical composition : from the latter by colour, inferior lustre, perfect cleavage, low degree of transparency, inferior hardness, greater specific gravity, and chemical composition.

Second Subspecies.

Ceylanite *

Ceylanit, *Werner*.

Schorl ou Grenat brun, *Romé de Lisle*, t. iii. p. 180. Note 21.—Ceylanit, *La Metherie*, Journ. de Phys. 1793, p. 23.—Pleonaste, *Haüy*, t. iii. p. 17. *Id. Broch.* t. ii. p. 525.—Ceylanite, *Reuss*, b. ii. th. ii. s. 38. *Id. Lud.* b. ii. s. 148. *Id. Suck.* 1r th. s. 148.—Pleonast, *Bert.* s. 284. *Id. Mohs*, b. i. s. 100. *Id. Lucas*, p. 52. 263.—Spinelle pleonast, *Brong.* t. i. p. 438. *Id. Steffens*, b. i. s. 27.—Spinelle noir-purpurin, bleu, vert, *Haüy*, Tabl. p. 31.—Zeilanit, *Hoff.* b. i. s. 530.—Pleonast, *Haus.* Handb. b. ii. s. 363.—Pleonast, *Aikin*, p. 185.

External Characters.

Its colour is muddy duck-green, and greyish-black, which approaches to iron-black.

It occurs in blunt angular pieces, and grains; and crystallized in the following figures;

1. Octahedron, either perfect, or truncated on the edges. Figs. 9, and 10. Pl. 1.
2. Octahedron, having each of its angles acuminated by four planes, which are set on the lateral planes. Fig. 11. Pl. 1.
3. Garnet or rhomboidal dodecahedron. Fig. 12. Pl. 1.

The crystals are small, and very small, seldom middle-sized; and sometimes imbedded, sometimes superimposed.

Externally

* The name *Ceylanite* is derived from Ceylon, one of the first known habitats of this mineral.

Externally the angular pieces and grains are rough and glimmering, or glistening, but the crystals are smooth and splendid.

Internally it is splendid, and the lustre is vitreous, inclining to semimetallic.

The fracture is perfect, and very flat conchoidal.

The fragments are indeterminate angular, and very sharp-edged.

It is translucent on the edges.

It scratches quartz and topaz, but not so readily as spinel, and is therefore softer than that gem.

It is rather easily frangible.

Specific gravity, 3.7647; or 3.7931, *Haüy*.

Chemical Character.

It is infusible before the blowpipe.

Constituent Parts.

Alumina,	-	-	68
Magnesia,	-	-	12
Silica,	-	-	2
Oxide of Iron,	-	-	16
Loss,	-	-	2
			<hr/>
			100

Collet Descotil, Ann. de Chem. xxxiii.

Geognostic and Geographic Situations.

This mineral was first found in the Island of Ceylon, where it occurs in the sand of rivers, along with tourmaline, zircon, sapphire, and iron-sand. It also occurs in the ejected unaltered rocks at Monte Somma. These rocks are sometimes calcareous, sometimes composed of leucite, felspar, mica, quartz, and olivine, and contain their

their cavities octahedral crystals of ceylanite. It occurs also in the trap rocks near Andernach on the Rhine, and in the supposed volcanic rocks of Valmaargue, Montferrier, and at Lestz near Montpellier.

It thus appears to be an inmate of secondary trap rocks; probably also of volcanic rocks; and if the loose rocks of Somma are primitive, of primitive rocks.

Observations.

This mineral is distinguished from *Spinel*, by its semimetallic lustre, inferior hardness, greater weight, and inferior transparency. When it occurs in grains, it is apt to be confounded with *Tourmaline*, but its semimetallic lustre, greater weight, and its not becoming electric by heating, distinguish it from that mineral.

Third Subspecies.

Spinel*.

Spinell, Werner.

Rubinus balassus, Rubinus spinellus, *Wall.* t. i. p. 247.—Rubis spinelle octaëdre, *Romé de Lisle*, t. ii. p. 224.—Spinel, & Balass Rubies, *Kirw.* vol. i. p. 253.—Spinel, *Estner*, b. ii. s. 73. *Id. Emm.* b. i. s. 56, & b. iii. s. 252.—Rubino Spinello, *Nap.* p. 118.—Rubis, *Lam.* t. ii. p. 224.—Spinel, *Haiiy*, t. ii. p. 496. *Id. Broch.* t. i. p. 202. *Id. Bournon*, Phil. Trans. 1792, part ii. p. 305. *Id. Reuss*, b. ii. th. 2. s. 31. *Id. Lud.* b. i. s. 67. *Id. Such.* 1r th. s. 449. *Id. Bert.* s. 281. *Id. Mohs*, b. i. s. 101. *Id. Hab.* s. 36. *Id. Lucas*, p. 42.—Spinelle rubis, *Brong.* t. i. p. 436.—Spinell, *Brard*, t. i. p. 113.—Spinel Ruby, *Kid*, vol. i. p. 143.—Spinell, *Steffens*, b. i. s. 23. *Id. Haiiy*, Tabl. p. 31. *Id. Haus*, b. ii. s. 360. *Id. Hoff.* b. i. s. 535. *Id. Aikin*, p. 185.

External

name is first mentioned by the earlier writers of the middle ages, reason is unknown.

External Characters.

The principal colour is red; from which there is a transition on the one side into blue, and almost into green; on the other side into yellow and brown, and even into white. Thus it passes on the one side from carmine-red into cochineal-red, crimson-red, and cherry-red, into plum-blue, violet-blue, and indigo-blue; the indigo-blue sometimes inclines to green: on the other side it passes from crimson-red into blood-red, and hyacinth-red, into a colour intermediate between orange and ochre yellow, into yellowish-brown, and reddish-brown. From the cochineal-red it passes through rose-red into reddish-white. The colours are seldom pure, being generally somewhat muddy. The blue and white varieties are rare, and the green variety is very rare.

It occurs, sometimes in grains, more frequently crystallized. The grains are usually rolled crystals.

The following are its crystallizations:

1. Perfect octahedron, which is the fundamental figure. Fig. 13 *.
2. Octahedron, with alternate larger and smaller planes.
3. Tetrahedron, slightly truncated on the angles. Fig. 14 †.
4. Perfect tetrahedron. Fig. 15.
5. Tetrahedron, deeply truncated on the apex ‡.
6. Segment of figure 3.
7. Two segments of the tetrahedron, truncated on the angles, as in figure 3. joined together in a conformable

* *Spinelle primitif*, Haüy.—Romé de Lisle, t. ii. p. 224. Pl. 3. fig. 1.

† Romé de Lisle, p. 227. var. 5. Pl. 3. fig. 2.

‡ Romé de Lisle, var. 6. Pl. 3. figs. 10, 11. and 12.

[Subsp. 3. Spinel.

formable manner by their bases, forming a *twin-crystal* with three re-entering angles.

8. Two segments of the tetrahedron, truncated on the angles, (as in figure 3.), joined together by their bases in an unconformable manner, so that the extremities of the segments project. *Twin-crystal*.
9. Two crystals, N^o 5. attached by their bases. *Twin-crystal*. Fig. 16 *.
10. A crystal of N^o 6. attached by its base to the lateral plane of a crystal N^o 5. *Twin-crystal*.
11. A crystal of N^o 10. attached to one of N^o 13. *Triple-crystal*.
12. Octahedron, in which two opposite planes are much larger than the others.
13. Thick equiangular six-sided table, in which the terminal planes are set alternately oblique on the lateral planes. Sometimes the table is elongated, when it assumes more the appearance of a
14. Very oblique four-sided table, which is truncated on both the acute angles.
15. Octahedron, truncated on the edges. Fig. 17 †.
16. Rhomboidal dodecahedron. Fig. 18.
17. Octahedron, in which the axis is oblique, the edge of the common bases is truncated, and the apices sometimes rounded off.
18. Rectangular four-sided prism, acuminated by four planes, which are set on the lateral planes. Fig. 19.
19. Lengthened or cuneiform octahedron. Fig. 20 ‡.

All

* Spinnelle transposé, Haüy.—Romé de Lisle, var. 7. Pl. 3. fig. 16.

† Spinnelle emarginé, Haüy.—Romé de Lisle, t. ii. p. 226. var. 2. Pl. 3. fig. 7.

‡ Spinnelle prinitif cuneiformé, Haüy.—Romé de Lisle, t. ii. p. 226. var. 1 Pl. 3. fig. 2. & 33.

All the planes of the crystals that originate from the fundamental figure are smooth ; whereas those which are derived from truncations on the edges are streaked.

The crystals are generally small and very small ; seldom middle-sized *.

Externally and internally the spinel is splendid, and the lustre vitreous. Many crystals are invested with an opaline crust, and then have a pearly reflection.

The cleavage is fourfold, but imperfect, and the folia are parallel with the sides of an octahedron.

The fracture is flat conchoidal.

The fragments are indeterminate angular and sharp-edged, or they are splintery.

It alternates from translucent to transparent, and refracts single.

It scratches topaz, but is scratched by sapphire.

It is brittle.

Specific gravity, 3.500, 3.789, *Werner*. 3.645, *Haüy*. 3.570, 3.590, *Klaproth*. 3.705, *Lowry*. 3.5, 3.8, *Mohs*.

Chemical Characters.

Infusible before the blowpipe without addition ; but is fusible with borax.

Constituent Parts.

Alumina,	-	-	-	82.47
Magnesia,	-	-	-	8.78
Chromic acid,	-	-	-	6.18
Loss,	-	-	-	2.57
				100

Vauquelin, J. M. N^o 38. p. 89.

Geognostic

* Brard mentions a fine spinel, weighing 215 grains, which was intended for Josephine, the wife of Buonaparte.

Geognostic and Geographic Situations.

Europe.—It is found in the gneiss district of Acker in Sudermannland, in a white foliated granular primitive limestone, in which bronze-yellow coloured scales of mica are disseminated; and the crystals are sometimes intermixed with the limestone at their line of junction. It occurs in drusy cavities, along with vesuvian and ceylanite, in the ejected foliated granular limestone of Vesuvius.

Asia.—It occurs in the kingdom of Pegu, and at Cananor in the Mysore country. In the island of Ceylon, so prolific in gems, it is found not only in the sand of rivers, but also imbedded in gneiss*.

Uses.

It is used as a precious stone, being cut for various ornamental purposes; but it has neither the hardness nor fire of the red sapphire or oriental ruby. When it weighs four carats, (about sixteen grains), it is considered of equal value with a diamond of half the weight. Figures are sometimes cut upon it. It does not appear that the ancients ever cut figures on this mineral; for there is no mention made of antique engraved gems of this kind, by
any

* In the magnificent collection of the late Honourable Mr Greville, now in the British Museum, there are two interesting specimens, which, although they do not enable us to ascertain the repository or kind of rock in which the spinel occurs, make us acquainted with some of its accompanying minerals. In one of the specimens, crystals of spinel are imbedded in calcareous-spar, and accompanied with crystals of mica, magnetic-pyrites, and a substance which Count de Bournon believes to be asparagus-stone; and in the other specimen, the spinel is imbedded in adularia, and is accompanied with magnetic pyrites.

any of their writers ; and in the vast collections of engraved gems, preserved in different parts of Europe, there are none of spinel.

Observations.

1. *Distinctive Characters.*—*a.* Between Spinel and octahedral Zircon : In zircon, the principal crystallization is an obtuse four-sided pyramid, not a regular octahedron, as in spinel ; and the specific gravity of zircon is higher, it being 4.4, whereas spinel is only 3.8.—*b.* Between Spinel and *Oriental Ruby* or *Red Sapphire* : Red sapphire is not only harder, but heavier than spinel.

2. The carmine-red variety is the *Spinel-ruby* of the jeweller : the cochineal-red variety is the *Balais-ruby* of jewellers, so named from Balacchan, the Indian name of Pegu, where this variety is found : the violet-blue spinel is the *Almandine of Pliny* ; is so named from Alabanda, a town in Lesser Asia, near which it was found ; and the orange-yellow variety is the *Rubicelle-ruby* of jewellers..

3. It is a remarkable circumstance, as noticed by Hausmann, that the precious stones of the North, such as the spinel-ruby of Acker, the physalite or topaz of Sweden, and the zircon of Norway, have less transparency and muddier colours than the same gems found in warmer climates.

2. Rhomboidal Corundum.

Rhomboedrischer Corund, *Mohs.*

This species contains four subspecies, viz. Salamstone. Sapphire, Emery, and Corundum.

First

First Subspecies.

Salamstone *.

Salamstein, *Werner*.

Salamstein, *Hoff. b. i. s.* 541.—Corindon hyalin, *Hauy*, *Tabl.* p. 38.

External Characters.

Its colours are, brownish-red, carmine-red, crimson-red, and cochineal-red; also violet-blue and Berlin-blue.

It occurs in grains, which are rolled pieces, and crystallized in

1. Six-sided prisms, in which the lateral faces are ribbed.

2. Rhomboids, with truncated summits.

Internally it is shining and vitreous.

The cleavage is, in the direction of a rhomboid of $86^{\circ} 38'$, but is very difficultly discoverable.

The fracture is conchoidal.

The fragments are indeterminate angular and sharp-edged.

It is translucent, and exhibits a particular kind of opalescence in two directly opposite places.

It is so hard as to scratch all other minerals but diamond.

Specific gravity not determined.

Geographic Situation.

It occurs principally in the Peninsula of India.

* *Salamstone* is the Indian name for this gem.

Second Subspecies.

Sapphire*.

Sapphir, *Werner*.

Saphirus, *Wall.* t. i. p. 248.—Rubinus orientalis, *Id.* p. 247.—Topazius orientalis, *Id.* p. 251.—Rubis d'orient, *Romé de Lisle*, t. ii. p. 212.—Oriental ruby, sapphire, and topaz, *Kirw.* t. i. p. 250.—Sapphir, *Estner*, b. ii. s. 86. *Id. Emm.* b. i. s. 67. & b. i. s. 251.—Zaffiro, et Rubin-zaffiro, *Nap.* p. 113. & 121.—Saphir, *Broch.* t. i. p. 207.—Telesie, *Haiiy*, t. ii. p. 480.—Perfect corundum, *Greville and Bournon*, Lond. Phil. Trans. 1798 & 1802.—Sapphir, *Reuss*, b. ii. th. 2. s. 24.—Rubin, *Reuss*, b. ii. th. 2. s. 20. *Id. Lud.* b. i. s. 67. *Id. Suck.* 1r th. s. 446. *Id. Bert.* s. 280. *Id. Mohs*, b. i. s. 128. *Id. Hab.* s. 36.—Telesie, *Lucas*, p. 40.—Corindon telesie, *Brong.* t. i. p. 427.—Corindon hyalin, *Brard*, p. 110.—Sapphir, *Kid*, vol. i. p. 137.—Corindon hyalin, *Haiiy*, Tabl. 60.—Sapphir, *Steffens*, b. i. s. 14. *Id. Hoff.* b. i. s. 547.—Edler corund, *Haus. Handb.* b. ii. s. 367.—Telesia, *Aikin*, p. 186.

External Characters.

Blue and red are its principal colours; it occurs also grey, white, green, and yellow. From indigo-blue it passes through smalt-blue, Berlin-blue, azure-blue, lavender-blue, into a kind of flesh-red, rose-red, crimson-red, peach-blossom-red, and cochineal-red. It occurs also pearl-grey, bluish-grey, milk-white, reddish-white, yellowish-white; which latter inclines strongly to lemon-yellow. It is sometimes of a deep green colour.

The

* The name *Sapphire* is of Grecian origin, and according to Stephanus Byzant, is derived from the island Sapphirine in the Red Sea. But the sapphire of the ancients appears to have been a different mineral from the present,—probably azure-stone.

The colours of sapphire are generally pure and light, seldom muddy and deep. Sometimes two, but more rarely three colours occur in the same specimen: these are white and blue, blue and red, white, blue, and red*.

It occurs in blunt-edged pieces, and in roundish grains, both of which are pebbles, and crystallized. Its crystallizations are as follows:

The primitive figure is a slightly acute rhomboid, or double three-sided pyramid, in which the alternate angles are $86^{\circ} 4'$, and $93^{\circ} 56' \dagger$. The following, which are the usual forms, can be traced to this rhomboid:

1. Very acute, equiangular, simple, six-sided pyramid.
Fig. 21. Pl. 2.
2. Preceding figure truncated on the summit. Fig. 22.
Pl. 2.
3. Perfect six-sided prism, Fig. 23. Pl. 2.; sometimes truncated on the alternate angles, Fig. 24. Pl. 2.
4. Acute, double, six-sided pyramid, in which the lateral planes of the one are set on the lateral planes of the other. Fig. 25. Pl. 2.
5. The preceding figure acuminated on the extremities by six planes, which are set on the lateral planes.
6. The preceding figure truncated on the extremities.
7. N^o 4. truncated on the extremities. Fig. 26. Pl. 2.
8. N^o 3.

D 2

* Roncé de Lisle mentions a sapphire among the crown jewels of France, which is of a beautiful yellow in the middle, and pure blue on the extremities. Faujas St Fond observed some sapphires which appeared green when viewed in the direction of their thickness, but blue in the direction of their length; and in the British Museum, there is a specimen which is blue and red at the extremities, and yellow in the middle.

† This is the determination of Phillips in the *Geological Transactions*, vol. iv. p. 224.

8. N^o 3. acutely acuminated with six planes, which are set on the lateral planes.

9. The preceding crystal truncated on the summit.
Fig. 27. Pl. 2.

10. N^o 1. acutely acuminated by six planes, which are set on the lateral planes.

11. The preceding figure truncated on the summit.

The crystals are small, middle-sized, and all around crystallized. The planes of the crystals are generally transversely streaked, and, when fresh, are usually splendid.

Internally, its lustre is splendid and vitreous, sometimes inclining to adamantine.

The cleavage is in the direction of the planes of a rhomboid of $86^{\circ} 4'$, or is parallel with the terminal planes of the prism. The cleavage is scarcely discernible in the blue varieties, the sapphire of the jeweller, but is pretty distinct in the red varieties, the oriental ruby of the jeweller.

The fracture is conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It alternates, from transparent to translucent; and the translucent varieties frequently exhibit a six-rayed opalescence.

It refracts double.

It is, after diamond, the hardest substance in nature; the blue varieties are harder than the red.

It is brittle, and easily frangible.

Specific gravity 4.320, 4.000, *Werner*.—4.283, 3.999, *Hayy*.—4.000, *Hatchet* and *Greville*.—4.161, 3.907, *Bournon*. Yellow Sapphire, 3.916; Blue Sapphire, 3.985; Red Sapphire, 3.975, *Lowry*.

Constituent Parts.

Blue sapphire.			Blue sapphire.			Red sapphire, or Oriental Ruby.		
Alumina,	-	98.5	-	-	92.0	-	-	90.0
Lime,	-	0.5	Silica,	-	5.25	-	-	7.0
Oxide of Iron,	-	1.0	-	-	1.0	-	-	1.2
			Loss,	-	1.75	-	-	1.8
<hr/>			<hr/>			<hr/>		
100			100			100		
<i>Klap. Beit. b. l. s. 88.</i>			<i>Chenevix, Phil.</i>			<i>Chenevix, Phil.</i>		
			Trans. 1802.			Trans. 1802.		

Chemical Character.

It is infusible before the blowpipe.

Physical Characters.

Becomes electrical by rubbing, and retains its electricity for several hours; but does not become electrical by heating.

Geognostic Situation.

It occurs in alluvial soil, in the vicinity of rocks belonging to the secondary or flötz-trap formation, and imbedded in gneiss.

Geographic Situation.

Europe.—It occurs in alluvial soil, along with pyrope, zircon, and iron-sand, at Podsedlitz and Trzibnitz in Bohemia; near Hohenstein in Saxony. In France, on the banks of the stream Riou Pezzoulou, near Expailly; also at Brendola in the Vicentine, and in Portugal.

Asia.—It is found particularly beautiful in the Capellan Mountains, twelve days journey from Sirian, a city of Pegu; it is said, also in Persia, and imbedded in gneiss in the Island of Ceylon.

Use.

Uses.

This mineral is, next to diamond, the most valuable of the precious stones. The white and pale-blue varieties, by exposure to heat, become snow-white, and when cut, exhibit so high a degree of lustre, that they are used in place of diamond. The most highly prized varieties are the crimson and carmine red; these are the *Oriental Ruby* of the jeweller, and next to the diamond, are the most valuable minerals hitherto discovered. The blue varieties, the *Sapphire* of the jeweller, are next in value to the red. The yellow varieties, the *Oriental Topaz* of the jeweller, are of less value than the blue or true Sapphire.

The *Asterias* or *Star-stone* is a very beautiful variety, in which the colour is generally of a reddish violet, and the form a rhomboid, with truncated apices, which exhibit an opalescent lustre. If cut *en cabochon*, or in the form of an ellipse, the summit of the ellipse being situated exactly over the point corresponding with the summit of the rhomboid, there will be produced the appearance of a star with six rays, from which, when held in the sunshine, a bright yellowish light shoots forth, forming a beautiful contrast to the rich violet-blue of the other part of the gem.

Sapphire is now usually set with a foil of its own colour; but it was formerly the practice, instead of a foil, to place under the gem the blue part of a peacock's feather.

A sapphire of ten carats weight, is considered to be worth fifty guineas.

An oriental ruby of thirty-one carats weight, of perfect colour, and without flaws, is considered as even more valuable

[Subsp. 2. Sapphire.]

luable than a diamond of the same weight. It is usually set with a foil; but if peculiarly rich in colour, it is sometimes set without a bottom or *à jour*, that the stone may be seen through.

In the construction of time-keepers, no stones have been found sufficiently hard for jewelling the holes, except the ruby and the diamond.

It does not appear that the ancients ever engraved figures upon this mineral. All the engraved sapphires preserved in collections, are of modern date; and of these, one of the most beautiful is a red sapphire, or oriental ruby, on which is cut the figure of Henry the Fourth of France. This gem was engraved by the celebrated artist Coldere, and was in the collection of the late Duke of Orleans.

Observations.

1. Sapphire was first established as a distinct species, and separated from spinel, with which it had been confounded, by Romé de Lisle and Werner.

2. Red sapphire and spinel ruby are sometimes confounded together. The following characters will assist in discriminating them:

Red sapphire shows in some specimens milky reflections; it has generally a sensible tint of violet, when we place it near the eye, and look through it.

Spinel-ruby does not show the milky reflections, and when placed very near the eye, and looked through, shows only a pale rose-red colour.

3. The following are the names given to the different varieties of this mineral:

a. Blue

- a. Blue sapphire. *True or oriental sapphire.*
- b. Crimson red sapphire. *Oriental ruby.*
- c. Yellow sapphire. *Oriental topaz.*
- d. Violet-blue sapphire. *Oriental amethyst.*
- e. Pearl-grey or bluish-grey sapphire. *Vermeille or Calcedonic ruby.*
- f. Green sapphire. *Oriental emerald or Oriental peridot.*
- g. White sapphire. *Lux sapphire.*

4. Certain varieties of sapphire exhibit particular kinds of opalescence, and these have received the following denominations.

(1.) *Girasol sapphire.* This variety exhibits a pale-red-dish and bluish reflection upon a transparent ground.

(2.) *Opalescent sapphire.* This variety shews a very bright pearly opalescence.

(3.) *Asteria sapphire or Star-stone,* already described.

5. The Kings of Pegu, Ava and Siam, are reported to possess rich collections of oriental rubies. The finest ruby at present known belongs to the King of Pegu. Tavernier states, that in the throne of the Great Mogul there were 108 rubies, which, on an average, weighed from 100 to 200 carats each. Probably many of these were garnets. Among the crown jewels of France, there is a fine rhomboidal crystal of sapphire, of the weight of 166 carats.

6. The best sapphires and rubies come from Ava and Pegu; those of Ceylon are usually of a pale colour, and are often deteriorated by stains and streaks. The European varieties of this gem are not esteemed by jewellers.

7. We may here remark, that the epithet *Oriental*, frequently applied to the finer kinds of gems, was adopted in consequence of its having been observed, that the hardest precious stones came from the East.

Unira Subspecies.

Emery.

Schmirgel, Werner.

Smirgel, *Reuss*, b. ii. th. 2. s. 156. *Id. Broch.* t. ii. p. 292.—
 Smirgel, *Lud.* b. ii. s. 183. *Id. Suck.* 2. th. s. 298. *Id. Bert.*
 s. 427. *Id. Mohs*, b. i. s. 136.—Corindon granuleux, *Lucas*,
 p. 260. *Id. Brard*, p. 111.—Emeril, *Brong.* t. i. p. 431.—
 Corindon granulaire, *Haüy*, Tabl. p. 30.—Schmirgel, *Steffens*,
 b. i. s. 21. *Id. Hoff.* b. i. s. 561. *Id. Haus.* b. ii. s. 370.—
 Emery, *Aikin*, p. 187.

External Characters.

Its colour is intermediate between greyish-black and bluish-grey.

It occurs massive and disseminated; and the massive is sometimes intermixed with other minerals.

It sometimes occurs in fine granular distinct concretions.

Its lustre is glistening, passing into glimmering, and is adamantine.

The fracture is fine and small grained uneven; sometimes splintery.

The fragments are indeterminate angular, and rather blunt-edged.

Is slightly translucent on the edges.

It is hard in a high degree; scratches topaz.

Is rather difficultly frangible.

Specific gravity 4.0.

Constituent Parts.

Alumina,	-	86.0
Silica,	-	3.0
Iron,	-	4.0
Loss,	-	7.0

 100

According to *Tennant*, Phil. Trans. for 1802.

Geognostic Situation.

We know only the geognostic situation of the Saxon emery, which occurs in beds of talc and steatite, along with blende and calcareous spar, in primitive clayslate. This substance is to be considered as bearing the same relation to sapphire that limestone does to calcareous spar; hence emery, in a general view, may be considered massive sapphire.

Geographic Situation.

Europe.—It is found at Ochsenkopf near Schwartzenberg, and Eibenstock in Saxony. Jersey and Guernsey are mentioned as localities of this species; but Dr MacCulloch, who examined these islands, could neither find it, nor learn that it ever had been discovered there*.

It occurs abundantly in the island of Naxos, in large loose masses, at the foot of primitive mountains, and also at Smyrna. It is mentioned as a production of Parma in Italy, and of Ronda, in the kingdom of Granada, in Spain.

Asia.

* MacCulloch, Geological Transactions, vol. i. p. 12.

[Subsp. 3. *Emery*.

Asia.—Near the town of Charlowa in the Altain Mountains.

America.—Mexico and Peru.

Use.

It is used for polishing hard minerals and metals, and hence is an important article in the arts. Before using, it is ground into powder of various degrees of fineness, according to the use that is intended to be made of it. The different kinds of powder are obtained, by repeatedly diffusing the ground emery in water, and allowing the water to settle a longer or shorter time, according as a fine or coarse powder is wished. It is used with water for polishing stones; but with oil for polishing metals.

Observations.

1. The name *Emery* is one of technical import, and was long applied to all those hard substances employed in the polishing of gems and other hard minerals: Such as fine granular garnet, named Red Emery; actynolite and quartz, mixed with iron-glance and other oxides of iron. These mixtures were at one time considered as simple minerals, and when the iron was the predominating ingredient, were placed along with the ores of iron, but under the name *Emery*. To obviate this irregularity, Werner restricted the name *Emery* to the present species, which has all the characters of a good emery, and is well marked as a distinct mineral.

2. Some very hard ores of iron, found in Sweden, which are used as emery, are probably intermixed with true emery.

Fourth Subspecies.

Corundum.

Korund & Demant-Spath, *Werner*.

Korund, *Wid.* s. 237.—Adamantine-spar, *Kirw.* vol. i. p. 335.—Demant-spath, *Emm.* b. i. s. 9. & b. iii. s. 229.—Spatho adamantino, *Nap.* p. 223.—Corindon, *Lam.* t. ii. p. 356.—Le spath adamantine, *Broch.* t. i. p. 356.—Corindon, *Haiiy*, t. iii. p. 1.—Imperfect Corundum, *Greville & Bournon*, Phil. Trans. 1798 and 1802.—Korund & Demant-spath, *Reuss*, b. ii. th. 2. s. 16, & 12. *Id. Lud.* b. i. p. 103. *Id. Suck.* 1r th. s. 439. *Id. Bert.* s. 290. *Id. Mohs*, b. i. s. 112, & 120.—Corindon harmophane translucide, & Corindon harmophane opaque, *Lucas*, p. 259, & 260.—Corindon adamantine, & Corindon adamantine noiratre, *Brong.* t. i. p. 429, 430.—Corindon harmophane, *Brard*, p. 110.—Corindon harmophane opaque. *Haiiy*, Tab Comparat. p. 30.—Korund, & Demant-spath, *Steffens*, b. i. s. 17, & 19. *Id. Hoff.* b. i. s. 565, & 572.—Demant-spath, *Haus.* Handb. b. ii. s. 368.—Common Corundum, *Aikin*, p. 187.

External Characters.

Its colour is greenish-white, of various degrees of intensity, which passes into light greenish-grey, and even into mountain-green, asparagus-green, Berlin-blue, and azure-blue; it is sometimes also pearl-grey, which passes into flesh-red, cochineal-red, crimson-red, and hair-brown. The green, blue, and red colours are generally muddy, and inclining to grey.

When cut in a semicircular form, it often presents an opalescent star of six rays.

It

It occurs massive, disseminated, in rolled pieces, and crystallized. Its principal crystallizations are the following:

1. Equiangular six-sided prism.
2. Same prism, having its alternate angles truncated.
3. Same prism, having its terminal edges and alternate angles truncated.

4. When the truncations on the angles of N° 2. increase very much in magnitude, there is formed a three-planed acumination, in which the acuminating planes are set on the alternate lateral edges of the prism.

5. When the truncations on the edges increase very much, a six-planed acumination is formed; and when the prism becomes very short, or disappears, there is formed a simple six-sided pyramid; and if the prism is acuminated on both extremities, a double six-sided pyramid; and in both cases the summits of the pyramids are truncated.

The crystals are middle-sized.

Externally, they are dull and rough.

It shews a tendency to straight lamellar concretions.

The lustre of the cleavage and fracture is shining and glistening, and is either vitreous inclining to resinous, or pearly inclining to adamantine.

The cleavage is perfect, and in the direction of the planes of a rhomboid of $86^{\circ} 4'$, or is parallel with the terminal planes of the prism.

The fracture is small and imperfect conchoidal, and sometimes uneven.

The fragments are indeterminate angular, and sharp-edged.

It alternates from strongly translucent to translucent on the edges, and it refracts double.

It

It is so hard as to scratch quartz; but is softer than sapphire.

It is rather easily frangible.

Specific gravity, 3.710, *Klaproth*.—3.873, *Haüy*.—875, *Bournon*. 3.876, *Leonhard*.

Chemical Character.

It is infusible without addition before the blowpipe.

Constituent Parts.

Corundum of the Carnatic.		Of Malabar.		Diamond spar, or Corundum of China.		Diamond spar, Etenengo.
Alumina,	91.0	-	86.5	-	84.0	- 92.0
Silica,	5.0	-	7.0	-	6.50	- 4.8
Iron,	1.5	-	4.0	-	7.50	- 2.4
Loss,	2.5	-	2.5	-	2	- 0.8
	<hr/> 100		<hr/> 100		<hr/> 100	<hr/>
			<i>Chenevix.</i>		<i>Klaproth.</i>	<i>Vauquelin,</i> <i>J. de Phys.</i> t. 74. p. 465

Geognostic and Geographic Situations.

Europe.—Red and blue corundum occur in dolomite in St Gothard; in mica-slate in Italy; in magnetic ironstone in Sweden; in nests of mica and felspar, which are contained in beds of greenstone porphyry subordinate to gneiss in Mount Rosa; and at Etenengo, near Mozzo, in the district of Sessia in Piedmont, in a granitic rock of felspar and silver-white mica.

Asia.—In the Carnatic, and on the coast of Malabar, it is imbedded in a rock composed of felspar, fibrolite, quartz, hornblende, and mica, and is sometimes accompanied with pistacite.

pistacite, talc, garnet, and zircon. It is also found very abundantly in the neighbourhood of Canton in China.

Use.

In its powdered state, it has long been used by the artists of India and China for cutting and polishing precious stones; but, although it will in some degree act upon the diamond, it is not sufficiently hard to bring out the fine lustre of that gem in a degree comparable to that which is effected by European artists with diamond powder. The Chinese also use it for polishing steel. European artists consider it superior to emery for the cutting of seals and precious stones; but for minute engraving it is much inferior to diamond-powder. Some authors say that the Chinese use it as an ingredient in their porcelain; but this opinion is called in question by late travellers.

Observations.

This mineral was known to Woodward, who mentions it under the name *Corivindum*. In the year 1768, Mr Berry, an eminent seal-engraver in Edinburgh, received a box of it from Madras. He showed it to Dr Black, who examined and pointed it out as a distinct and new mineral.

3. Prismatic

3. Prismatic Corundum or Chrysoberyl *.

Krysoberyll, *Werner*.

Cymophane, *Haüy*.

Prismatischer Corund, *Mohs*.

Chrysolithus colores reflectens varios; Chrysoberyllus, *Wall.* t. i. p. 216.—Krisoberill, *Wid.* s. 246. *Id.* *Kirw.* vol. i. p. 261. *Id.* *Estner*, b. ii. s. 63. *Id.* *Emm.* b. i. s. 19.—Crisoberillo, *Nap.* p. 134.—Chrysopal, *Lam.* t. ii. p. 244.—Le Chrysoberyl, *Broch.* t. i. s. 167.—Cymophane, *Haüy*, t. ii. p. 491.—Chrysoberyll, *Reuss*, b. ii. s. 48. *Id.* *Lul.* b. i. s. 60. *Id.* *Mohs*, b. i. s. 42.—Cymophane, *Lucas*, p. 41. *Id.* *Brong.* t. i. p. 425. *Id.* *Brard*, p. 111. *Id.* *Haüy*, *Tabl.* p. 30.—Krysoberyll, *Steffens*, b. i. s. 12. *Id.* *Hoff.* b. i. s. 424.—Chrysoberyll, *Haus.* b. i. s. 358.—Cymophane, *Aikin*, p. 188.

External Characters.

Its chief colour is asparagus-green: which passes on the one side into apple-green, mountain-green, and greenish-white; on the other side, through light-olive and oil-green, into light yellowish-grey, which inclines strongly to brown, and even passes to reddish-brown.

It often exhibits a milk-white opalescence †, which appears in general to float in the interior of the mineral.

It

* The name *Chrysoberyl* is derived from the Greek, (from χρυσος, gold, gold-yellow *Beryl*), but in ancient times was applied to a yellow variety of *Beryl*. The mineral which at present bears this name, was only first known in modern times.

† It is said that the opalescence does not always occur.

It occurs in blunt angular rolled pieces, that sometimes approach to the cubic form.

It is seldom found crystallized.

The primitive form is a prism of $104^{\circ} 41'$. The most frequent secondary forms are the following :

1. Short and broad six-sided prism, or thick table.

Fig. 28. Pl. 2.

2. Very short and broad six-sided prism or table, acuminated on both ends with six planes, set on the lateral planes, and the apices truncated. Fig. 29.

Pl. 2.

The crystals are small.

The surface of the rolled pieces is intermediate between rough and smooth, and is glistening.

Externally the crystals are shining ; internally splendid, and the lustre is intermediate between resinous and vitreous, but more inclining to the first.

The cleavage is observable only in the direction of the smaller diagonal of the prism.

The fracture is perfect conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It is semitransparent, sometimes inclining to transparent, and refracts double.

It scratches topaz, but does not affect sapphire.

It is brittle.

It is rather easily frangible.

Specific gravity, 3.720, *Werner*.—3.710, *Klaproth*.—3.7961, *Hauy*.—3.8, *Lucas*.

Constituent Parts.

Alumina,	-	71.5
Silica,	-	18.0
Lime,	-	6.0
Oxide of Iron,	-	1.5
Loss,	-	3.0

 100
According to *Klaproth*, b. i. s. 102.*Chemical Characters.*

Before the blowpipe it is infusible without addition, (*Lecievre*.)

Geognostic and Geographic Situations.

It occurs in Brazil, in alluvial soil with topaz, or in sandstone with diamond; and at Haddam, on Connecticut River, in the United States, in granite, along with garnets, beryl, and tourmaline*.

It is found in the island of Ceylon, in the beds of rivers, along with sapphires, rubies and tourmalines.

Uses.

This fine gem was formerly much less prized than it is at present. When cut and polished, it is not inferior in brilliancy and beauty to other gems of the same colour, but of much greater value. The larger stones are cut into necklaces and ring-stones, and set either with or without diamonds; the smaller ones are made into circular ear-drops, and set round with deep-coloured gems. The opalescent

* *Cleaveland's Mineralogy*, p. 204.

opalescent varieties are cut *en cabochon* as ring-stones, and are very much esteemed.

The Brazilian variety is better fitted for the purpose of the jeweller than the North American,

Observations.

1. Rolled pieces or pebbles of chrysoberyl might be confounded with pebbles of *sapphire*; but their green colour, milk or bluish white opalescence, frequent cubic form, rough and glistening surface, and inferior hardness, distinguish them sufficiently from that mineral. The crystallized varieties are distinguished from crystallized sapphire by colour and surface.

2. It was first established as a distinct species by Werner, in the *Bergmännisches Journal*, 3 Jahrg. 2. B. 54.

GENUS IV.—ANDALUSITE.

THIS genus contains one species, viz. Prismatic Andalusite.

1. Prismatic Andalusite.

Prismatischer Andalusit, *Mohs*.

This species contains two subspecies, viz. Common Andalusite and Saussurite.

First Subspecies.

Common Andalusite.

Andalusit, *Werner*.

Feldspath Apyre, *Haüy*.

Spath adamantin d'un rouge violet, *Bournon*, Journ. de Phys. 1799, p. 453.—Andalusit, *La Meth*. Id. An 6. p. 386. Id. *Reuss*, b. iv. s. 135.—Foretzer Feldspath, *Suck*. 1^r Abh. s. 396.—Andalusit, *Mohs*, b. i. s. 423. Id. *Karsten*, Tabel. s. 46. Id. *Leonhard*, Tabel. s. 19. Id. *Brong.* t. i. p. 369.—Feldspath apyre, *Haüy*, Tabl. p. 60.—Micaphilit, *Brunner*, in Moll's Ann. 3. 2. 294.—Andalusit, *Steffens*, b. i. s. 455. Id. *Hoff*. b. ii. s. 291. Id. *Lenz*, b. i. s. 484. Id. *Oken*, b. i. s. 317. Id. *Haus.* b. ii. s. 506. Id. *Aikin*, p. 187.

External Characters.

Its colour is flesh-red, which sometimes inclines to pearl-grey.

It occurs massive, and crystallized in slightly oblique four-sided prisms, in which the terminal angles and lateral edges are sometimes truncated.

The crystals are seldom large, generally middle-sized or small, and almost always imbedded.

The principal fracture is shining, in a low degree; the cross fracture glistening, and the lustre is vitreous.

The cleavage is indeterminate diagonal.

The fracture is uneven.

The fragments are indeterminate angular.

[Subsp. 1. Common Andalusite.

It is feebly translucent.

It scratches quartz, but is softer than topaz*.

It is rather easily frangible.

Specific gravity, 3.050, *Romé de Lisle*.—3.074, *Guyton*.

3.165, *Haily*.—3.060, 3.127, *Von Voith*.—3.2, *Mohs*.

Chemical Characters.

It becomes white before the blow-pipe, but does not melt. The andalusite of Herzogau was exposed by Bucholz for an hour and a half to a temperature equal to that of melting silver, when its colour was changed, its lustre almost destroyed, but it appeared to have increased in hardness and brittleness.

Constituent Parts.

Silica,	-	32	29.12
Alumina,	-	52	51.07
Potash,	-	8	
Oxide of Iron,		2	7.83
		<hr/> 94	<hr/> 88.02
		<i>Vauquelin.</i>	<i>Guyton.</i>

Geognostic Situation.

It occurs in gneiss, mica-slate, and clay-slate; also in veins that traverse granite or gneiss, either along with felspar, or with felspar, quartz, mica, and schorl.

Geographic

* Herr Von Voith says, that he found the schorl of Hörlberge, the steatite in gneiss near Werneberg, and the andalusite of Herzogau, so soft in their original repositories, that he could flatten them between the fingers, and cut them with a knife, but that they became very hard on exposure to the air.

Geographic Situation.

Europe.—It occurs in gneiss in Aberdeenshire; in granite in Banffshire; in mica-slate in the Island of Unst; Dartmoor in Devonshire; also in mica-slate on the north-east side of Douce Mountain, in the county of Wicklow; and at Killeny, in the county of Dublin, where it was first noticed by my friend Dr Blake *.

On the Continent it was first found in the province of Andalusia or Castile; afterwards by Count de Bournon at Imbert, near Monthbrison in Forez, in a vein of felspar traversing granite. It also occurs in veins in gneiss near Herzogau, in the Upper Palatinate; Syser Alp in Tyrol; and in gneiss near Bodenmais in Bavaria. In the Fichtelgebirge, and at Braunsdorf, near Freyberg in Saxony, it occurs imbedded in mica-slate.

America.—At Readfield in Mainè, United States, in granite †.

Observations.

1. It is distinguished by its colour, external shape, fracture, hardness, and weight. It has been confounded with *Felspar*; but it is distinguished from that mineral by its greater hardness, and weight, and its infusibility. Its cleavage, and inferior specific gravity, distinguish it from *Corundum*.

2. The finest specimens of andalusite are found in the Syser Alp.

Second

* *Pitt's Mineralogy* of Dublin, p. 47.

† *Cleveland's Mineralogy*, p. 265.

*Second Subspecies.***Saussurite**

Magerer nephrite, *Reuss*, b. ii. s. 192.—Jade, *Saussure*, *Voyage*
—Jade tenace, *Haüy*, t. iv. p. 368.—Jade de Saussure, *Brong*
t. i. p. 348.—*Saussurite*, *Karst.* Tabel. s. 34.—Feldspath te-
nace, *Haüy*, *Tabl.* p. 36.—*Saussurite*, *Theodore de Saussure*,
Journal des Mines, n. cxi. p. 205. *Id.* *Steffens*, b. i. s. 451.—
Variolit, *Hoff.* b. ii. s. 238.—*Saussurit.* *Lenz*, b. i. s. 507. *Id.*
Oken, b. i. s. 332. *Id.* *Haus.* b. ii. s. 537. *Id.* *Aikin*, p. 234.

External Characters.

Its colours are white, grey, and green: it passes from greyish-white into greenish-white, greenish-grey, bluish-grey, and mountain-green; and sometimes it occurs smoke-grey and pearl-grey.

It occurs massive, disseminated, and in rolled pieces.

Internally it is dull, or feebly glimmering.

The cleavage is imperfect, and apparently twofold, and slightly oblique?

The fracture is splintery.

It breaks into very sharp-edged pieces.

It is faintly translucent on the edges.

It is very difficultly frangible.

It is hard; according to *Saussure* it scratches quartz.

It is meagre to the feel.

Specific gravity, 3.200, *Klaproth*. 3.310, 3.319, *Saussure*.

Chemical Characters.

Before the blowpipe it melts on the edges and angles, but is not entirely melted.

Constituent

Constituent Parts.

Silica,	-	44.00	49.00
Alumina,	. -	30.00	24.00
Lime,	-	4.00	10.50
Magnesia,	- -		3.75
Natron,	-	6.00	5.50
Potash,	-	0.25	
Iron,	-	12.50	6.50
Manganese,	-	0.05	
		<hr/>	<hr/>
		96.80	99.25

Saussure, Journ. des
Mines, n. cxi. p. 217.

Klaproth, Beit
b. iv. s. 278.

Geognostic and Geographic Situations.

It occurs at the foot of Mount Rosa. Rolled pieces are found at the mouth of the Rhuss; and large blocks, containing diallage, abound in the Pays de Vaud. Rolled masses are scattered on the shores of the Lake of Geneva; and the well-known rock from Corsica, named *Verde di Corsica*, is a compound of diallage and saussurite. It is also found in Norway, Finland, Italy, France, and Savoy.

Observations.

The older Saussure, who has particularly described this mineral, was of opinion that it belonged to the magnesian class, and arranged it in the system under the name *Jade*. Saussure the Younger, after a careful examination and analysis, found that it could not be arranged with jade, but formed a distinct species, to which he gave the name *Saussurite*. Hatty described it under the name

[Subsp. 2. *Saussurite*.

name Feldspath tenace, and Werner arranges it with the feldspars; but its great hardness, and high specific gravity, induce me to retain it as a distinct mineral, and from its affinity with andalusite, to place it beside that species.

GENUS V.—TOPAZ.

This genus contains but one species, viz. Prismatic Topaz.

Prismatic Topaz.

Prismatischer Topaz, *Mohs*.

The species contains three subspecies, viz. Common Topaz, Schorlite, and Physalite or Pyrophyssalite.

First Subspecies.

Common Topaz *.

Topaz, *Werner*.

Chrysolithus, *Plin.* Hist. Nat. l. xxxvii. 9.—Topazius octaedricus prismaticus, *Wall.* t. i. p. 251.—Topaze du Brezil, *Romé de Lisle*, t. ii. p. 230.—Topaze de Saxe, *Id.* p. 260.—Topaz, *Wern.* Cronst. p. 97. *Id. Wid.* p. 267.—Occidental Topaz, *Kirw.* vol. i. p. 254.—Topaz, *Estner*, b. ii. s. 98. *Id. Emm.* b. i. s. 374.—Topazio, *Nap.** p. 136.—Topaze du Brezil, de Saxe, et de Siberie, *Lam.* t. ii. p. 254. *Id. Broch.* t. i. p. 212. *Id.*

* The name *Topaz* is derived from Topazos, a small island in the Red Sea, where, it is said, the Romans used to collect their topaz, which is the Chrysolite of the moderns.

Id. Haüy, t. ii. p. 504.—Topaz, *Reuss*, b. ii. th. ii. s. 40. *Id. Lud.* b. i. s. 68. *Id. Suck.* 1r th. s. 455. *Id. Bert.* s. 294. *Id. Mohs*, b. i. s. 27. *Id. Hab.* s. 54. *Id. Lucas*, s. 43. *Id. Brong.* t. i. p. 419. *Id. Brard*, p. 116. *Id. Kid*, vol. i. p. 145. *Id. Haüy*, Tabl. p. 17. *Id. Steffens*, b. i. s. 33. *Id. Hoff.* b. i. s. 377.—Edler Topaz, *Haus. Handb.* b. ii. s. 649.—Topaz, *Aikin*, p. 147.

External Characters.

Its principal colour is wine-yellow, which occurs of all degrees of intensity.

The pale wine-yellow passes into yellowish-white, greyish-white, greenish-white, mountain-green, and celandine-green.

The dark wine-yellow passes from orange-yellow through cherry-red into violet-blue*.

It seldom occurs massive, composed of coarse and small granular concretions, disseminated, and in rolled pieces; most frequently crystallized.

Its primitive form is an oblique prism of $124^{\circ} 22'$.

The following are the principal varieties of the prism.

1. Oblique four-sided prism, rather acutely acuminated by four planes, which are set on the lateral planes.
2. N^o 1. in which the acuter lateral edges are bevelled; or it may be viewed as an eight-sided prism, in which two and two lateral planes meet under obtuse angles. Fig. 30. Pl. 2.
3. N^o 1, & 2, with a double acumination; the planes of the second acumination set on those of the first.

4. N^o 2.

* The violet-blue variety is very rare; in proof of this, it may be mentioned, that Mr. Von der Null of Vienna, the proprietor of one of the most beautiful and instructive cabinets in Europe, and which has been excellently described by Mohs, paid 1500 ducats for a single specimen of violet-blue coloured topaz.—Vid. Von Moll's *Epitheriden*.

4. N° 2. with a triple acumination; in which the planes of the one always rest on those of the others..
5. N° 2. in which the angles on the acute edges, and the summits of the acuminations, are truncated. Fig. 31. Pl. 2.
6. N° 4. in which the angles on the acute and obtuse edges are truncated. Fig. 32. Pl. 2.
7. N° 1, & 2., in which the summits of the acuminations are truncated.
8. The preceding figure, in which the angles formed by the obtuse lateral edges and the acuminate planes, are bevelled.
9. The bevelling edges of N° 8. truncated.
10. The preceding figure, in which the edges formed by the truncating planes of the bevelment with the surrounding planes, are truncated.
11. N° 2, in which the terminal planes are bevelled, and the bevelling planes set on the acute lateral edges.
12. The preceding figure, in which the angles formed by the proper edge of the bevelment are bevelled. Fig. 33. Pl. 2.

The crystals are middle sized, small and very small; very seldom large; and are generally superimposed.

The lateral planes of the crystals are longitudinally streaked; but the acuminate and bevelling planes are smooth; the terminal planes are rough*.

The

* The Brazilian and Siberian topazes are more deeply streaked than the Saxon: further, the Brazilian topaz is generally acuminate, but is without truncations; the Siberian, on the contrary, is usually bevelled.

The massive varieties occur in coarse and small granular distinct concretions.

Externally it is splendent; internally, splendent and vitreous.

The cleavage is perfect, and perpendicular to the axis of the prism.

The fracture is small and perfect conchoidal.

The fragments are indeterminate angular and sharp-edged, and sometimes tabular.

It alternate, from transparent to semitransparent; and it refracts double.

It is harder than quartz or emerald; but softer than corundum.

It is easily frangible.

Specific gravity 3.464 to 3.556, *Werner*.—3.556 to 3.564, *Häuy*.—3.540 to 3.576, *Kursten*.—3.532 to 3.641, *Lowry*.—3.4, 3.6, *Mohs*.

Chemical Characters.

Saxon topaz in a gentle heat becomes white*, but a strong heat deprives it of lustre and transparency: the Brazilian, on the contrary, by exposure to a high temperature, burns rose-red†, and in a still higher violet-blue. Before the blowpipe it is infusible, but exposed to a stream of oxygen gas it soon melts into a porcellaneous bead. It is fusible with borax, but alkali has little effect on it.

Physical

* When thus altered, the Saxon topaz is sometimes imposed on the ignorant for diamond.

† Topaz thus altered, is cut and sold by jewellers under the name of Brazilian ruby and Pale spinel.

Physical Characters.

The topaz of Brazil, Siberia, Mucla in Asia Minor, and Saxony, when heated, exhibits at one extremity positive, and at the other negative electricity. It also becomes electrical by friction, and retains this property for a considerable time, sometimes more than twenty-four hours.

Constituent Parts.

	Brazilian Topaz.	Saxon Topaz.	Saxon Topaz.
Alumina,	58.38	57.45	59
Silica,	34.01	34.24	35
Fluoric acid,	7.79	7.75	5
	<hr/> 100.18	<hr/> 99.44	<hr/> 99

Berzelius, Afhand- *Berzelius*, id. *Klap.* b. 4. s. 160.
lingar, vol. iv.
p. 236.

Geognostic Situation.

Topaz occurs in many different rocks and mineral repositories. It forms an essential constituent part of a particular mountain-rock, which is an aggregate of topaz, quartz, and schorl, and is named *topaz-rock*. The rock is composed of large and small globular and angular concretions, having a slaty structure; and between the concretions there are frequently drusy cavities lined with crystals of topaz, quartz, schorl, and lithomarge. At first sight it appears to be an aggregation of fragments, but a particular examination convinces us that all the remarkable phenomena it exhibits are effects of crystallization. Topaz occurs in drusy cavities in granite, along with beryl and rock-crystal; also in veins, which

which traverse primitive rocks, as granite, where it is associated with beryl, rock-crystal, and iron-ochre, or mica-slate and gneiss, where it is accompanied with tinstone, arsenical pyrites, sometimes copper-pyrites, apatite, fluor-spar, quartz, and steatite. It has been also discovered in nests, in transition clay-slate, along with red-coloured quartz, brown-spar, and selenite or gypseous spar; in chlorite-slate, associated with lithomarge and quartz; and it is found in rolled pieces and crystals in alluvial soil.

Geographic Situation.

Europe.—It occurs in large crystals, and rolled masses, in an alluvial soil, in the granite and gneiss districts of Mar and Cairngorm, in the upper parts of Aberdeenshire*; and in veins, along with tinstone, in clay-slate, at St Anne's, in Cornwall; also in St Michael's Mount, and at Trevaunance, in the same county. Upon the Continent of Europe, it appears most abundantly in topaz-rock at Schneckenstein; also in veins that traverse gneiss, along with tinstone, fluor-spar, and arsenical pyrites, at Ehrenfriedersdorff; and in rounded or angular pieces, and sometimes in crystals of a mountain-green colour, in alluvial soil, at Eibenstock in Saxony; it also occurs at Zinnwald and Geyer in the same country; at Schlackenwalde and Zinnwald in Bohemia, it occurs in veins that traverse gneiss, along with tinstone, fluor-spar, copper-pyrites, and lithomarge. It has been found at Hirschberg, and other places in Silesia, and at the Höllengraben, at Werfen in Salzburg, in nests in transition clay-slate.

Asia.—It occurs both in the Altain and Uralian mountains. In the Altain range, it occurs on the banks of the river

* Vid. *Wernerian Transactions*, vol. I. p. 445,—452.

river Tom; and in the mountain Adon-Tschelon, along with beryl, quartz, schorl, fluor-spar, and lithomarge. About twenty-five leagues north of Catharinenburg in the Uralian range, it is found in considerable quantity in a kind of granite, resembling that variety known under the name of Graphie Granite. There, it is said to occur in drusy cavities, along with rock-crystal and beryl. It has been discovered in loose crystals in Kamschatka; and it is said also along with rock-crystal, common quartz, &c. in the river Poyk in Caucasus. The beautiful rose-red variety was discovered at Mukla, in Asia Minor, by an intelligent traveller, our countryman Mr Hawkins. In Ceylon, Pegu, Hawkesbury river in New Holland, and Cape Barren Island in Bass's Straits, it occurs in alluvial soil.

America.—The topazes of Brazil, so much esteemed in trade, are dug in the district of Villa Rica. The higher parts of the country are of sandstone, which is sometimes flexible, (this is the well known *flexible sandstone* of Brazil,) owing to intermixed chlorite; but in the lower, the prevailing rock is chlorite-slate. The topazes are found in nests in this slate, and are generally associated with lithomarge, loose granular quartz, and rock-crystal; and occasionally they are included in the rock-crystal*. Crystals of topaz twelve inches long, and from four to six inches thick, are met with in these cavities. They are also found in the alluvium of the country. In the National Museum in Paris, there is a large rock-crystal, containing red-coloured topazes from Brazil.

Uses.

* It is said, by Mr Mawe, that the blue topaz of Brazil occurs in the same sandstone rock as that which surrounds the diamond.

Uses.

1. This gem is much prized by jewellers. The following kinds are known in commerce.

a. Saxon. The colours are yellow, and generally pale wine-yellow. When cut, they frequently have a lustre equal to the Brazilian, but are not so much esteemed.

b. Bohemian are found in the tin mines of that country; are small, deficient in transparency; the only colours are grey or muddy white; and hence they are not esteemed.

c. Aqua-marine. Under this name are included the mountain-green varieties of topaz found in the alluvial rocks of Eibenstock, in veins and drusy cavities in Siberia, and, we may add, in alluvial soil, in the upper parts of Aberdeenshire. They are not so highly valued as the Brazilian.

d. Yellow Brazilian Topaz. The most esteemed have a deep and pure yellow colour. The yellow topazes of Brazil are at present the most highly valued by jewellers.

e. Blue Brazilian Topaz,—named also *Brazilian sapphire*. This beautiful gem is rare, and sells at a high price. It has been found to vary in size from a few carats to three ounces and upwards.

f. White Topaz of Brazil. This variety, which is of a greyish or snow-white colour, is known in Brazil under the name *minas novas*. It generally occurs of small size, and is used in circular car-rings, or is set round yellow topazes.

g. Taurian Topaz, Is of a pale-blue colour, and is also esteemed.

2. This gem was much prized by the ancients. In proof of this, it may be mentioned, that Cleopatra presented a
fine

[Subsp. 1. Common Topaz.

fine stone of this kind to Antony; and that Ovid adorns the chariot of the sun with it. Figures are sometimes engraved on it; and these, when well executed, are very highly valued. In the National Museum in Paris, there is a superb Indian Bacchus engraved on topaz. In the cabinet of the Emperor of Russia there are several fine engraved topazes; and the King of Spain had in his possession a Brazilian topaz, on which was admirably engraved the portraits of Philip II. and Don Carlos.

3. Other minerals are sometimes sold for topaz, as yellow-coloured Rock-crystal, in this country named *Cairngorm-stone*, from the place where it is found, or *Scots topaz* *. Even very fine varieties of Calcedony and Carnelian, when well cut and set, have been imposed on the ignorant as topaz.

4. Coarse kinds of topaz are pounded and used as a kind of emery in cutting hard minerals.—Lastly, it may be mentioned, that topaz was formerly kept in the apothecaries shops, and sold as a powerful antidote against madness.

Observations.

1. Topaz may in general be distinguished from all other minerals, by the rhomboidal base of its crystals, straight foliated cross cleavage, and longitudinal streaked lateral planes.

2. It cannot readily be confounded with yellow-coloured *Sapphire*, because sapphire is harder and heavier, and does not, like the greater number of topazes, become electric by

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heating:

* The large mass of yellow transparent stone, which was preserved in the collection of the Stadtholder under the name Topaz, is but a fragment of rock-crystal.

heating : Nor can we mistake red topaz for *Spinel*, because spinel is harder, refracts only single, whereas topaz refracts double ; and spinel does not become electric by heating, as is the case with topaz : And green-coloured topaz is readily distinguished from *Beryl*, by the following characters : It does not exhibit cleavages parallel with the lateral planes, as is the case with beryl ; its prism has a rhomboidal base, which is not the case with the prism of beryl ; and its specific gravity is 3.5, but that of beryl only 2.7.

3. When colour was considered as affording the most certain means of distinguishing the precious stones from each other, many different minerals were associated with the topaz, and varieties of topaz were described as distinct species ; as appears from the following tables :

1.

Minerals which have been confounded with Topaz.

- | | |
|---|---|
| 1. Yellowish-white sapphire, | Oriental topaz. |
| 2. Zircon, | Hyaline topaz, and yellowish-red topaz *. |
| 3. Chrysolite, | Yellowish-green topaz †. |
| 4. Yellowish beryl, | Siberian topaz. |
| 5. Yellowish rock-crystal, | Bohemian, Scotch, or Occidental topaz. |
| 6. Clove-brown and brownish-black rock-crystal, | Smoke topaz. |
| 7. Yellow fluor-spar, | False topaz. |

* Wall. edit. 1774 & 1. p. 252.

2.

Names given to particular varieties of Topaz.

- | | |
|--|---|
| 1. Mountain-green topaz, | Aqua-marine. |
| 2. Blue topaz, | Sapphire. |
| 3. Yellow topaz, | Chrysoprase, <i>Baillon</i> , Cat.
p. 137. |
| 4. Wine-yellow, inclining to
red topaz, | Rubicelle. |
| 5. Red topaz, | Brazilian or Balais ruby. |
| 6. Yellowish-green topaz. | Saxon chrysolite. |

4. In the collection of minerals in the Museum of Natural History at Paris, there is a Brazilian topaz which weighs 4 ounces and a quarter, and is the largest specimen in that great national repository. In the upper parts of Aberdeenshire, much heavier and larger specimens of real topaz have been found. In the first volume of the *Wernerian Memoirs*, we find mentioned a specimen weighing 1 pound 3 ounces 8 drams and $8\frac{1}{2}$ grains, troy weight, from Aberdeenshire; and we understand that larger masses have been since discovered.

Seconda Subspecies.

Schorlite, or Schorlous Topaz.

Schörlartiger Berill, or Piknit, *Werner*.Pycnite, *Haüy*.

Weisser Stangenschöerl, *Wern.* Cronst. p. 199.—Schorl blanc prismatique, *Romé de Lisle*, t. ii. p. 420.—Schörlartiger berill, *Wid.* p. 276.—Shorlite, *Kirwan*, vol. i. p. 286. *Id. Estner*, b. ii. p. 207.—Sorlo bianco, *Nap.* p. 152.—Leucolite, *Lam.* t. ii. p. 274.—Leucolite, et Pycnite, *Haüy*, t. iii. p. 236.—Le Beril schorliforme, *Broch.* t. i. p. 124.—Stangenstein, *Reuss*, b. ii. th. i. s. 110.—Schörlartiger berill, *Lud.* b. i. s. 70. *Id. Mohs*, b. i. s. 155.—Stangenstein, *Hab.* s. 52.—Pycnite, *Lucas*, p. 78. *Id. Brong.* t. i. p. 418. *Id. Brädd*, p. 191.—Topaz septihexagonale, et Topaz cylindroide, *Haüy*, Tabl. p. 18.—Schorlit, *Steffens*, b. i. s. 37.—Schörlartiger Beril, *Hoff.* b. i. s. 620.—Gemeiner Topaz, *Haus.* b. ii. s. 648.—Pycnite, *Aikin*, p. 192.

External Characters.

Its principal colour is straw-yellow, which passes into yellowish-white, and is sometimes spotted red and grey.

It occurs almost always massive, composed of parallel, thin, and straight prismatic distinct concretions, which are longitudinally streaked, and crystallized in long six-sided prisms, which are sometimes truncated on the terminal edges and angles, and are generally imbedded.

The crystals are large and middle sized.

Externally and internally its lustre is shining, approaching to glistening, and is resinous.

The cleavage is the same as in common topaz, but not so distinct.

The

[Subsp. 2. *Schorlite*, or *Schorlous Topaz*.

The fracture is small and imperfect conchoidal, or fine-grained uneven.

The fragments are indeterminately angular, and not particularly sharp-edged.

It is more or less translucent on the edges.

It is nearly as hard as common topaz.

It is brittle.

It is uncommonly easily frangible.

Specific gravity, 3.530, *Klaproth*.—3.514, *Hauy*.—3.535 and 3.503, *Huberle*.

Chemical Characters.

Before the blowpipe it is infusible without addition; with borax it melts into a pure transparent glass.

Physical Character.

Like topaz, it becomes electric by heating.

Constituent Parts.

Alumina,	-	-	51.00
Silica,	-	-	38.43
Fluoric Acid,	-	-	8.84
			<hr/>
			98.27

Berzelius in *Afhandlingar*, vol. iv. p. 236.

Geognostic and Geographic Situations.

It occurs at Altenberg in Saxony, in a rock of quartz and mica, which forms an imbedded mass, included in porphyry. This mass is a compound of quartz, chlorite, mica, felspar, lithomarge, fluor-spar, iron-pyrites, copper-pyrites, arsenical pyrites, iron-glance, molybdena, wolfram, native bismuth,

muth, and bismuth-glance. At Schlackenwald in Bohemia, it is imbedded in an aggregate of quartz, tinstone, wolfram, and molybdena, which forms a mass in gneiss. In Siberia it occurs along with mica and quartz; and at Mauleon in France is imbedded in scatite.

Observations.

1. *Distinctive Characters.*—*a.* Between schorlite and beryl. The colour-suite of beryl is different from that of schorlite; both external and internal lustre of beryl is much higher than that of schorlite; and in beryl the lustre is vitreous, whereas it is resinous in schorlite; beryl is easily frangible, schorlite uncommonly easily frangible; beryl has a specific gravity of 2.7; schorlite is 3.5.—*b.* Between schorlite and topaz. The colour-suite of topaz is different from that of schorlite; both external and internal lustre of topaz much exceed that of schorlite, and the lustre is vitreous, not resinous, as is the case with schorlite; schorlite occurs in prismatic concretions, which is never the case with topaz; topaz is more transparent than schorlite; and, lastly, topaz is easily frangible, schorlite uncommonly easily frangible.

2. It received the name *schorlite* from Klaproth, on account of general resemblance to schorl. It may be named *schorlous topaz*.

Third

*Third Subspecies.***Physalite, or Pyrophysalite.****Pyrophysalith, *Hisinger*.****Physalith, *Werner*.**

**Pyrophysalith, *Afhandlingar i Fysik, Kemi och Mineralogie*,
1. th. p. 111,–118.; *Tillagning*, p. 239, 240.; *Annal. de*
Chem. 1806, n. 173. p. 113,–124. *Id. Steffens*, b. i. s. 40.—
Topaz prismatoide, blanc-verdatre, translucide ou opaque,
Haüy, *Tabl.* p. 18.—*Gemeiner Topaz, Haus.* b. ii. s. 648.—
Pyrophysalite, Aikin, p. 191.**

External Characters.

Its colours are greenish-white and mountain-green.

It is massive.

It occurs in coarse granular distinct concretions.

The lustre of the cleavage is splendid, of the cross fracture glistening or dull.

The cleavage is perfect, and the same as that of topaz.

The fracture is uneven or conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It is translucent on the edges.

It is as hard as topaz.

Specific gravity 3.451.

Chemical Characters.

Before the blowpipe it becomes white and opaque, and acquires a slight vitreous glazing, at the same time disengaging minute bubbles of gas.

Constituent Parts.

Alumina,	-	-	57.74
Silica,	-	-	34.36
Fluoric Acid,	-	-	7.77
			<hr/>
			99.87

Afhandlingar, vol. iv. p. 236.*Geographic Situation.*

It is found imbedded in granite at Finbo, near Fahlun, in Sweden.

GENUS VI.—EMERALD.

THIS genus contains two species, viz. Prismatic Emerald and Rhomboidal Emerald.

1. Prismatic

1. Prismatic Emerald, or Euclase *.

Euclas, *Werner*,

Euclase, *Haüy*.

Prismatischer Smaragd, *Mohs*.

Euclase, *Journal des Mines*, n. 28. p. 258.—*Euclasi*us, *Lin. Syst. Nat.* ed. 13. *Lipsiæ*, 1793, t. iii. p. 442.—Euclase, *Daubenton*, *Tabl.* p. 6. *Id. Haüy*, t. ii. p. 531. *Id. Broch.* t. ii. p. 508. *Id. Lud.* b. i. s. 165. *Id. Suck.* 1st th. s. 165. *Id. Lucas*, p. 45. *Id. Brong.* t. i. p. 413. *Id. Brard*, p. 121. *Id. Kid*, vol. i. p. 133. *Id. Haüy*, *Tabl.* p. 32. *Id. Steffens*, s. 47. *Id. Hoff.* b. i. s. 592. *Id. Haus.* *Handb.* b. ii. s. 654.—Euclase, *Aikin*, p. 192.

External Characters.

Its colour passes, on one side, from greenish-white through mountain-green, and celandine-green, into dark sky-blue; on the other side into apple-green, with a trace of blue.

It has been hitherto found only crystallized.

The primitive form is a prism of $133^{\circ} 24'$. The following are all the secondary forms hitherto described, and which may be traced to the prism just mentioned:

1. Oblique four-sided prism, rather acutely acuminate by four planes, which are set on the lateral planes.
2. The preceding figure, slightly truncated on the lateral edges.
3. The preceding figure, in which two of the acuminate planes meet under an obtuse angle, so that the prism appears with a very oblique bevelment.

4. The

* The name *Euclase* is derived from the Greek *eu* and *κλαω*, and refers to the great fragility of the mineral.

4. The preceding figure, in which the bevelling planes are once broken.
5. Oblique four-sided prism, in which the lateral edges are bevelled, and the edges of the bevelment on the acute edges truncated. On the extremity of the prism there are three acuminations of four planes each, which are set on each other, and correspond to the lateral planes of the prism; but these planes are modified by a suite of bevelments, which are placed on their obtuse lateral edges; there is also a bevelment (with triangular planes) between these and the bevelment on the obtuse lateral edges of the prism; and, lastly, a truncation on each of the superior edges of the truncations on the acute lateral edges of the prism. Fig. 34. Pl. 2.

The lateral planes are more or less longitudinally streaked; seldom smooth. The streaks give to the planes a rounded appearance, and the prisms then appear reed-like.

Externally the crystals are shining and splendid, and vitreous; internally splendid.

The cleavage is perfect, straight, and in the direction of the smaller diagonals of the prism.

The fracture is small conchoidal.

The fragments are tabular, and frequently almost cubical.

It alternates from transparent to translucent, and refracts double.

It is harder than quartz, but softer than topaz.

It is very easily frangible:

Specific gravity, 3.06, *Haiiy*.—2.907, *Lowry*, from a specimen in possession of Mr Rundell of London.—3.32, *Mohs*.

Chemical

Chemical Characters.

Before the blowpipe, it first loses its transparency, and then melts into a white enamel.

Constituent Parts.

Silica,	-	35	to 36
Alumina,	-	18	19
Glucina,	-	14	15
Iron,	- -	2	3
Loss,	- -	31	27

100 100

Vauquelin.

The loss in these analyses appears owing, partly to water of crystallization, and partly to an alkali.

Geognostic and Geographic Situation.

This rare and beautiful mineral was first found in Peru, from whence it was brought to Europe by the traveller Dombey. Very lately it has been brought from Brazil in isolated crystals, that appear to have been imbedded. The Brazilian euclase was discovered in the mine of Gerais near Casson.

Observations.

1. It is a very beautiful mineral; but, on account of its easy frangibility, cannot be used in jewellery.

2. It is named *euclase* by Haüy, on account of its very great frangibility.

3. The greater part of the description of this mineral was drawn up by M. Verina, from specimens in the possession of Mr Edmund Rundell, and Mr Heuland of London.

2. Rhomboidal Emerald *.

Rhomboedrischer Smaragd, *Mohs*.

THIS species is divided into two subspecies, viz. Precious Emerald and Beryl.

First Subspecies.

Precious Emerald †.

Schmaragd, *Werner*.

Gemma pellucidissima, *Smaragdus*, *Wall.* t. i. p. 253.—*Emeraude du Perou*, *Romé de Lisle*, t. i. p. 245.—*Schmaragd*, *Wern.* *Cronst.* p. 102. *Id. Wid.* p. 271.—*Emerald*, *Kirm.* vol. i. p. 247.—*Schmaragd*, *Estuer*, b. ii. p. 132.—*Smeraldo*, *Nap.* p. 122.—*Emeraude*, *Lam.* t. ii. p. 227. *Id. Broch.* t. i. p. 217.—*Emeraude verte*, *Haüy*, t. ii. p. 516.—*Smaragd*, *Reuss*, b. ii. th. 1. s. 165. *Id. Lud.* b. ii. s. 69. *Id. Suck.* 1st th. s. 205. *Id. Bert.* s. 308. *Id. Mohs*, b. i. s. 140. *Id. Hab.* s. 25.—*Emeraude*, *Lucas*, p. 44.—*Beril emeraude*, *Brong.* t. i. p. 417. *Id. Brard*, p. 119.—*Emerald*, *Kid.* vol. i. p. 130.—*Glatte smaragd*, *Karsten*, *Tabell.*—*Emeraude verte*, *Haüy*, *Tabl.* p. 32.—*Schmaragd*, *Steffens*, b. i. s. 41. *Id. Hoff.* b. i. s. 596.—*Edler Smaragd*, *Haus.* *Handb.* b. ii. s. 656.—*Emerald*, *Aikin*, p. 193.

External Characters.

Its characteristic, and, we may say, almost its only colour,

* *Mohs* names this species *rhomboidal*, because its principal figure, the regular six-sided prism, like all forms of the same description, can be traced to a rhomboid. This cannot be done with any of the pyramidal, tessular, or oblique prismatic forms.

† The true meaning of the name *Emerald*, is uncertain. In the writings of antiquaries, vague conjectures are proposed in regard to it, which may be read by those curious in such subjects.

lour, is emerald green, of all degrees of intensity, from deep to pale. The deep sometimes inclines a little to verdigris-green, and oftener to grass-green; the pale varieties sometimes nearly pass into greenish-white.

It seldom occurs massive, or in rolled pieces; most frequently crystallized.

The primitive form is an equiangular six-sided prism *, of which the following varieties occur:

1. Truncated on the lateral edges †.
2. Truncated on the terminal edges ‡.
3. On the terminal angles ||.
4. Terminal edges bevelled. When the truncations on the lateral edges increase, a
5. Twelve-sided prism is formed §.

The lateral planes are smooth; the terminal planes rough.

The crystals are middle-sized and small, very rarely large; and occur imbedded, or in druses.

Internally the lustre is intermediate between shining and splendid, and is vitreous.

The cleavage is straight, and fourfold, of which the folia are parallel with the lateral and terminal planes; but is difficultly discoverable.

The fracture is small, and imperfect conchoidal.

The fragments are indeterminate angular, and sharp-edged.

If

* *Emeraude primitive*, Haüy.—Romé de Lisle, t. ii. p. 250. Pl. 4. fig. 18.

† *Emeraude peridodécèdre*, Haüy.—Romé de Lisle, t. ii. p. 252. var. 1. Pl. 4. fig. 22.

‡ *Emeraude annulaire*, Haüy.—Romé de Lisle, p. 254. var. 2. Pl. 6. fig. 46.

|| *Emeraude épointée*, Haüy.—Romé de Lisle, var. 3. Pl. 4. fig. 100.

§ *Emeraude soustractive*, Haüy.

It alternates from transparent to translucent, and refracts double in a moderate degree.

It is harder than quartz, and nearly as hard as topaz.

Specific gravity, 2.600, *Werner*.—2.775, *Brisson*.—2.7227 to 2.7755, *Hauy*.—2.692, of a cut specimen in possession of Mr Rundell, *Lowry*.—2.8, *Hauy* on Precious Stones.—2.6, 2.8, *Mohs*.

Chemical Characters.

If heated to a certain degree, (120°) it assumes a blue colour, but it recovers its own proper tint on cooling. If the heat is carried to 150° , it melts into a white vesicular glass.

Constituent Parts.

Silica,	64.5	68.50
Alumina,	16	15.75
Glucina,	13	12.56
Oxide of Chrome,	3.25	0.30
Lime,	1.6	0.25
Water,	2.0	Oxide of Iron, 1.0
		Loss, 1.70
	<hr/>	<hr/>
	100.35	100.
<i>Vauquelin</i> , Jour. des Mines,		<i>Klaproth</i> ,
N. 38, p. 98.		Beit. iii. 226

Geognostic Situation.

It occurs in drusy cavities, along with iron-pyrites, calcareous-spar, and quartz, in veins that traverse clay-slate; also imbedded in mica-slate; and loose in the sand of rivers and other alluvial deposits.

Geographic

Geographic Situation.

The most beautiful emeralds are at present brought from Peru. The most ancient mine is that of de Manta, which is now exhausted; the other emerald mine is situated in the valley of Tunca, in the jurisdiction of Sante Fe, between the mountains of New Granada and Popayan. It occurs imbedded in mica-slate in Heubachthal, Salzburg. The Romans are said to have procured it from Æthiopia and Upper Egypt.

Use.

The colour which characterises this gem is extremely pleasing: the eye, after viewing the beautiful colours of the sapphire, oriental ruby, spinel and topaz, reposes with delight on the fresh and animating colour of the emerald, the charming emblem of the vegetable kingdom. It is rare, however, to find the colour pure and of good strength; hence such specimens are very highly valued, and are employed in the most expensive kinds of jewellery. It is valued next to the ruby; and when of good colour, is set without a foil, and upon a black ground, like brilliant diamonds. Emeralds of inferior lustre are generally set upon a green gold foil. These gems are considered to appear to greatest advantage when cut in the table form, and surrounded with brilliants, the lustre of which forms an agreeable contrast with the soft hue of the emerald. They are sometimes formed into pear-shaped ear-drops, necklaces and tiaras; but the most valuable stones are generally set in rings. In South America, it is a favourite mode of setting emeralds to form them into clusters of artificial flowers on gold stems.

The

The largest emerald mentioned by authors, is one said to have been in the possession of the inhabitants of the Valley of Manta, in Peru, at the time when the Spaniards first arrived there. It is recorded to have been as large as an ostrich's egg, and to have been worshipped by the Peruvians, under the name of the Goddess, or Mother of Emeralds. Of late years, specimens of emerald, from six to eight inches in length, and two inches in thickness, have been brought from Peru; but such are extremely rare.

Observations

1. Emerald and Beryl have a strong resemblance to each other: thus both are green, their crystallizations differs but little, and fracture, hardness and weight, are nearly the same. Notwithstanding these agreements, they are distinguished from each other by the following characters: Emerald occurs only green, but beryl, besides green, is also yellow and blue; the crystals of beryl are long, those of emerald are short; the lateral planes of beryl are streaked, those of emerald are almost always smooth; the terminal planes of beryl are smooth, those of emerald are rough; beryl is more distinctly foliated than emerald; beryl often presents distinct concretions, emerald never; beryl often shews a formation by acicular shoots, emerald never; beryl has transverse rents, emerald never; and the crystals of beryl are larger than those of emerald; and beryl is rather softer than emerald.

2. Many of the emeralds described by the ancients appear to have been varieties of green fluor-spar. Even in more modern times, fluor-spar has been preserved for emerald. Mr Coxe examined the famous emerald table in the Abbey of Reichenau, near Constance, which he found to be a very fine green-coloured fluor-spar. The famous

sacro

sacro cattino di smeraldo orientale, preserved at Genoa, and which could only be seen by an order from the Senate, is a mass of cellular glass. Many fine Ethiopian emeralds, which were bequeathed to monasteries, appear to have been sold by the monks, and coloured glass substituted in their place.

3. This mineral was named *smaragdus* by the ancients. Pliny distinguished twelve species of the *smaragdus*; but under this title he includes, besides the true emerald, also green jasper, prase, malachite, fluor-spar, serpentine, and translucent varieties of gypsum. Theophrastus also mentions the true emerald, which he says occurs in small quantity, and very rarely: he enumerates along with it another mineral of a green colour, which, he informs us, is found in masses ten feet long, and is probably a variety of serpentine. The emerald with which the hall of Assuerus was paved; the pillars of emerald in the temple of Hercules at Tyre, mentioned by Herodotus; and the large emeralds described by Pliny as having been cut into columns and statues, (thus, the statue of Serapis in Egypt, nine ells long, is said to be of emerald,) cannot be referred to the true emerald. The confusion that prevails in the descriptions of this mineral in ancient authors, has led some mineralogists to believe, that the true emerald was not known in Europe until after the conquest of Mexico and Peru by the Spaniards. The following facts, however, are in opposition to this opinion.

(1.) The emerald was so highly prized by the Romans, that when the luxurious and rich Lucullus landed at Alexandria, he was presented by Ptolemy with an emerald, on which was engraven a portrait of the king of Egypt; and this was considered as the most valuable present that could be offered to him.

(2.) In the National Museum in Paris, there is a fine emerald, on which is engraved an eye, which is known to by a very common Egyptian hieroglyphic.

(3.) In the mitre of Pope Julius II. which was presented to Pius VII. by Buonaparte, there is a fine deep green coloured emerald. As he died in 1513, and Peru was not discovered and conquered by Pizarro before 1545, it is highly probable that this emerald was brought from Africa.

(4.) Werner had in his possession several antique emeralds; and Mr Hawkins informed the Abbé Estner, that he had seen a necklace of emeralds, which was found among the ruins of Portici near Naples.

4. The ancients attributed many virtues to the emerald; thus they maintained, that the sight of its animating and refreshing colour chased away melancholy; that it completely prevented the fatal effects of poison, and even cured the most obstinate diseases.

5. The *Brazilian emerald* is a variety of Tourmaline; and the *Oriental emerald* is green-coloured Sapphire.

6. Emerald is one of the lightest and softest of the precious stones.

Second Subspecies.

Beryl*.

Edler Beril, *Werner*:

Beryllus, *Plin.* Hist. Nat. xxxviii. 5. 20.—Smaragdus, Aqua marina, et Smaragdus Berillus, *Wall.* t. i. p. 254.—Aigue marine†

* The name *Beryl* is of great antiquity, being mentioned by *Pliny*; but its derivation is unknown.

marine de Siberie, *Romé de Lisle*, t. ii. p. 252. *Id. Born.* t. i. p. 71.—Edler Berill, *Wern. Cronst.* §. 100.—Beryl, *Kirr.* vol. i. p. 248.—Edler Beril, *Wid.* s. 274. *Id. Estner*, b. ii. s. 197.—Berillo, *Nap.* p. 125.—Aigue-marine, *Lam.* t. ii. p. 232.—Emeraude, *Haiiy*, t. ii. p. 516.—Le Beril noble, *Broch.* t. i. p. 220.—Gestreifter Smaragd, *Reuss*, b. ii. th. 1. s. 102.—Edler Beril, *Lud.* b. i. s. 70. *Id. Suck.* 1^r th. s. 208. *Id. Bert.* s. 310. *Id. Mohs*, b. i. s. 146.—Gestreifter Smaragd, *Hab.* s. 26.—Beril aigue-marine, *Brong.* t. i. p. 415.—Emeraude vert-bleuatre, *Brard*, p. 12.—Beryl, *Kid*, vol. i. p. 128.—Emeraude vert-bleuatre et jaune-verdatre, *Haiiy*, *Tabl.* p. 32.—Beril, *Steffens*, b. i. s. 44. *Id. Hoff.* b. i. s. 604. *Id. Haus*, b. ii. s. 656. *Id. Aikin*, p. 193.

External Characters.

Its principal colour is green, from which it passes on the one side into blue, and on the other into yellow. It is commonly mountain and celandine green: from these it passes through apple-green, grass-green, asparagus-green, oil-green, into honey-yellow, which approaches to wine-yellow. From celandine-green it passes into smalt, sky, and, in rare instances, into azure blue*.

Almost all its colours are pale, seldom deep, and scarcely ever dark. Sometimes two colours occur together, which alternate in layers, and occasionally it is iridescent.

It occurs massive, and thus variety sometimes appears arranged in straight and thin prismatic distinct concretions. It is often crystallized in long equiangular six-sided prisms, which are either perfect, or truncated on the lateral edges, as in fig. 35. Pl. 2.; truncated on the terminal angles, as

G 2

in

* A rose-coloured variety, associated with red tourmaline, has been found in Chesterfield, in Massachusetts, in North America, and is in possession of Colonel Gibbs, a distinguished promoter of science in the United States.

in fig. 36. Pl. 2.; or on the terminal edges and angles, as in fig. 37. Pl. 2.

The truncations on the terminal edges sometimes become so large as to form six-planed acuminations, in which the apices appear deeply truncated, as in fig. 37. Pl. 2.

The lateral planes are deeply longitudinally streaked, but the terminal, acuminating, and truncating planes are smooth.

The lateral planes vary much in breadth; sometimes three planes are so large in comparison of the others, that the crystal appears almost trihedral: in other instances, four planes are so large, that the figure is almost tetrahedral. Sometimes the lateral planes are cylindrical convex, and then the crystals appear acicular or reed-like.

The crystals are sometimes jointed like basalt, having a concave surface at one extremity, and a convex surface at the other. They are seldom single; generally many occur together, and these cross each other in different directions, and are frequently superimposed and imbedded.

The crystals are small, large, and very large.

Transparent crystals occur a foot long, and four inches in diameter*.

Externally its lustre is shining and glistening; internally shining, which sometimes passes into glistening and splendid, and is vitreous.

The cleavage is the same as in precious emerald, but much more distinct, and more easily detected.

The fracture is small, and more or less perfect conchoidal.

The

* In Weiss's collection in Vienna, there is a druse of very large beryl crystals; two of the crystals, which are of a mountain-green colour, and cross each other, are a foot and a half in length, and one foot in diameter. Very large crystals are found in North America.

The fragments are indeterminate angular, and more or less sharp-edged.

It is commonly transparent, but sometimes passes into translucent, and it refracts double, but in a feeble degree. The translucent variety has cross rents.

It scratches quartz, and is nearly equal in hardness to topaz, with which the mountain-green variety has been often confounded.

It is easily frangible.

Specific gravity 2.6500 to 2.7590, *Werner*.—2.682 to 2.683 to 2.722, *Brisson*.—2.664, *Lowry*.—2.6, *Haüy*.

Chemical Characters.

Before the blowpipe it is difficultly fusible without addition, but with borax it melts easily.

Constituent Parts.

Silica,	69.50	68.0
Alumina,	14.00	15.0
Glucina,	14.00	14.0
		Lime, 2.0
Oxide of Iron,	1.00	1
	<hr/> 98.50	<hr/> 100

Rose, in *Karsten's*
Tabellen.

Varuquelin, *Jour. des*
Mines, N. 43. p. 563.

Geognostic Situation.

It occurs in veins that traverse granite and gneiss, along with rock-crystal, felspar, topaz, schorl, and iron-ochre; also imbedded in granite, and dispersed through alluvial soil.

Geographic

Geographic Situation.

Europe.—It occurs in alluvial soil along with rock-crystal and topaz, in the upper parts of Aberdeenshire*. In Ireland, imbedded in granite, near Lough Bray, in the county of Wicklow, and near Cronebane in the same county†.

It occurs imbedded in granite on the south side of the Rathhausberg in Gastein in Salzburg, and on the highest summit of the Saualpe in Carinthia. In granite in the island of Elba, and in large crystals in veins of quartz that traverse granite near to Limoges; also at Marmagne, and a little to the west of Nantz in France.‡

Asia.—The finest beryls are found in veins that traverse the granite mountain Adon-Tschalon in Dauria; from which quarter nearly all the abundant supplies of Russian beryl are obtained. It also occurs, along with arsenical pyrites, in a kind of serpentine rock near Nertschinsk; in the mountain Tygirek (Mountain of Snow) in the Altain range; on the borders of the River Lena; near the town of Ajatskaja in the Uralian range; and in the circle of Alepasski in Persia.

America.—This gem is found in several districts in the United States, as near Baltimore in Maryland, where it is imbedded in granite; on the banks of the Schuylkill, and in Germantown in Pennsylvania, also in granite; in New-York, in veins which traverse gneiss near the city, and in granite at Singing, thirty-five miles from the city; in different places in Connecticut in massive granite, and in granite veins traversing gneiss, where crystals seven inches in length,

* Vid. *Memoirs of the Wernerian Society*, vol. i. p. 445,—452.

† Fitton, Stephens, and Weaver, *Geological Transactions*, vol. i. p. 275.

[Subsp 2. Beryl.

length, by nine inches in diameter, have been found; at Chesterfield in Massachusetts in granite, in crystals that vary from a small size to that of a foot in diameter; and in different places in the district of Maine, either in coarse granular granite, or in graphic granite veins that intersect gneiss, and the contiguous gneiss contains imbedded beryl crystals*.

Very beautiful varieties of beryl are found in Brazil.

Uses.

When pure, it is cut into ring-stones, seal-stones, brooches, intaglios, and necklaces, but is not so highly valued as emerald. The darkest green varieties are set upon a steel coloured foil, and the pale ones are either placed like the diamond on a black ground, or upon a silvery foil. Figures are sometimes engraved on it. In the royal library at Paris there is a portrait of Julia, the daughter of Titus, engraved on a green-coloured beryl. The largest ones are said to be in much esteem among the Turks for the handles of stiletos. The varieties most highly prized by the jeweller, are brought from Brazil, Siberia, and Ceylon; others of inferior value are found in Scotland, France, and the United States of America.

Observations.

This gem was well known to the ancients, who procured it from several places where it is at present found. Pliny has given a good description of it,†; yet in later times this description

* Cleaveland's Mineralogy, p. 277.

† Plin. Hist. Nat. lib. xxxviii. c. 1.

description appears to have been forgotten; for we find it arranged with other precious stones, to which it had but little resemblance: thus the blue varieties were named Sapphire; the yellow, Topaz; and the green, Aqua-marine. Many years ago Werner obtained a complete suite of specimens of this mineral from Siberia, which enabled him to give it its proper place in the system.

GENUS VII. TOURMALINE*.

THIS genus contains one species, viz. Rhomboidal Tourmaline.

1. Rhomboidal Tourmaline.

Rhomboedrischer Turmalin, *Mohs*.

It is divided into two subspecies, viz. Tourmaline and Schorl.

First

* *Tourmaline*, according to Thunberg, is a Ceylanese word, and is pronounced in the Malabar and Cingalese language *Turemalin*.—Vid. Thunberg's Beschreibung der Mineralien und Edelgesteine der Insel Zeylon, in den Neuen Abhand. der Schwed. Acad. d. Wiss. Bd. 5. s. 79.

First Subspecies.

Tourmaline.

Turmalin, *Werner*.

Zeolites electricus, Turmalin, *Wall.* t. i. p. 329.—Schorl transparent rhomboidal, *Romé de Lisle*, t. ii. p. 344.—Brasili-
anischer Turmalin, *Wid.* p. 284.—Tourmaline, *Kirw.* vol. i.
p. 271.—Sorlo Brasiliano, *Nap.* p. 150.—Tourmaline, *Lam.*
t. ii. p. 295.—Le Schorl électrique, *Broch.* t. i. p. 229.—Tour-
malines vertes et bleus, *Hallé*, t. iii. p. 31.—Edler Schorl,
Reuss, b. ii. th. 1. s. 119. *Id. Lud.* b. i. s. 72. *Id. Suck.* 1^r th.
s. 221. *Id. Bert.* s. 191.—Turmalin, *Mohs*, b. i. s. 163. *Id.*
Hab. s. 33. *Id. Lucas*, p. 54.—Tourmaline cristallisé, &c.
Brong. t. i. p. 405.—Tourmaline, *Brard*, p. 140. *Id. Kid*,
vol. i. p. 233. *Id. Steffens*, b. i. s. 51.—Electrischer Schorl,
Hoff. b. i. s. 627.—Edler Turmalin, *Haus.* Handb. b. ii. s. 640.
—Tourmaline, *Aikin*, p. 217.

External Characters.

Its principal colours are green and brown: from leek-
green it passes into grass-green, pistachio and olive green,
then into liver-brown, and yellowish and reddish brown,
further into hyacinth-red, cochineal-red, rose-red, carnation-
red, vine-red, crimson-red, violet-blue, azure-blue, dark Berlin-
blue, and, lastly, into indigo-blue*. It is never black. In
some crystals the middle is of a red, but the exterior of a
green colour.

Its colours are almost all dark, often a little muddy; and
when

Honey-yellow and white are mentioned as colours of tourmaline.

when it is nearly opaque, on account of the darkness of the colour, it appears almost black.

It occurs very seldom massive, or in prismatic concretions; scarcely ever, disseminated; oftener in rolled pieces; but most frequently crystallized.

Its primitive form is a rhomboid of $133^{\circ} 26'$.

It occurs in the following forms, all of which may be traced to the rhomboid just mentioned.

Equiangular three-sided prism, *flatly acuminated* on the extremities with three planes, which on the one extremity are set on the lateral planes, on the other on the lateral edges.

The lateral edges are frequently bevelled, and thus a nine-sided prism is formed; when the edges of the bevelment are truncated, a twelve-sided prism is formed; and when the bevelling planes increase so much, that the original faces of the prism disappear, an equiangular six-sided prism is formed. The acuminations of these prisms exhibit very great variety of appearance; thus the angles, edges and extremities, are frequently truncated, and the angles bevelled. Fig. 39. Pl. 2. shews truncations on the angles of the acumination and bevelment of the lateral edges of the prism; PP, the original planes of the acumination; oo, the truncations on the angles. Fig. 40. Pl. 2. : in this the lateral edges of the prism are truncated. Fig. 41. Pl. 2. the angles formed by the meeting of two acuminating planes and one lateral plane bevelled; xx are the bevelling planes. When the truncations oo, on the angles of the acuminations, increase very much, there is formed a rather *acute acumination*, and the planes of the original acumination PP, appear as truncations on the edges formed by the meeting of the planes of this acumination, as in fig. 42. Pl. 2. When the truncations on the edges formed by the meeting

[Subsp. 1. *Tourmaline*.

meeting of the acuminating planes increase very much in size, a *very flat acuminations* is formed, and the planes of the original acuminations appear as truncations on the angles formed by the meeting of two of these planes, and one of the lateral planes of the prism. In fig. 43. Pl. 2. PP are the original acuminating planes, truncated on the edges *n*. In fig. 44. Pl. 2. the truncations *nnn* form a very flat acuminations, and the original planes PPP truncations on the angles of the acuminations, and the apex of the acuminations is truncated, *k* being the truncating plane. Sometimes the prism is nearly wanting, as in fig. 45. Pl. 2. when a double three-sided pyramid is formed, in which the lateral planes of the one are set on the lateral edges of the other, and the remainder of the prism forms truncations on the edges of the common base.

The lateral planes are generally cylindrical convex, and deeply longitudinally streaked; the acuminating planes are mostly smooth and shining: sometimes the planes on one extremity are smooth, but on the other rough.

The crystals are seldom large, more commonly middle-sized and small, and sometimes scopiformly aggregated, as is the case with the red variety from Siberia.

The crystals are usually imbedded.

Internally its lustre is splendid and vitreous.

The cleavage is threefold, and parallel with the sides of the rhomboid, $133^{\circ} 26'$.

The fracture is nearly perfect, and small conchoidal.

It alternates from nearly opaque to completely transparent. Refracts double in a middling degree.

When viewed perpendicular to the axis of the crystal, it is more or less transparent, but in the direction of the axis,

axis, even when the length of the prism is less than the thickness, it is opaque *.

It is as hard as quartz, some varieties even harder, but never so hard as topaz.

It is easily frangible.

Specific gravity.—Green tourmaline, 3.086, *Werner*.—3.086, *Brisson*.—From 3.0863 to 3.3626, *Haüy*.—Blue tourmaline, 3.155, *Werner*.—3.130, *Brisson*.—Green tourmaline, 3.191, *Lowry*.—3.0, 3.2 *Mohs*.

Physical Characters.

By friction, it exhibits signs of vitreous electricity; by heating, vitreous electricity at one extremity, and resinous electricity at the other. These electrical properties are stronger in some varieties than in others; the brown and hyacinth-red varieties shew the strongest electrical properties; the blue and green less, and the crimson-red the least. The electrical properties of this gem were known to the ancients, who named it *Lyncurium*.

Chemical Characters.

Before the blowpipe it melts into a greyish-white vesicular enamel; but the red-coloured Siberian tourmaline is infusible.

Constituent

* *Werner* had in his possession a tourmaline which is sky-blue in the middle, but violet-blue on the sides.

Constituent Parts.

Green Tourmaline from Brazil.		Violet Tourmaline from Siberia.		Red Tourmaline from Rosena.	
Silica,	40.	Silica,	42	Silica,	43.5
Alumina,	39.	Alumina,	40	Alumina,	42.2
Lime,	3.84	* Soda,	10	Soda,	9.
Oxide of Iron,	12.5	Oxide of Manganese,		Oxide of Manganese,	1.5
Oxide of Manganese,	2.	containing a little iron,	7	Lime,	0.1
Loss,	2.66	Loss,	1	Water,	2.4
	100 *		100		100
<i>Vauquelin</i> , Ann. de Chim. N. 88. p. 105.		<i>Vauquelin</i> , Ann. du Mus. t. iii. p. 243.		<i>Klaproth</i> , Journ. de Mines, N. 137 p. 383.	

Geognostic Situation.

Tourmaline generally occurs imbedded in beds, or in single strata, and but seldom distributed through the whole mass of a mountain. The rocks in which it most commonly occurs are gneiss, mica-slate, talc-slate, and indurated talc; and the accompanying minerals are rock-crystal, common quartz, felspar and mica. It occurs also in granite, but has not hitherto been discovered in any of the secondary rocks. It does not occur in primitive trap, nor in general it is associated with any of the subspecies of hornblende; in short, it appears to have little or no geognostic affinity with hornblende, although they have been frequently confounded together.

In alluvial countries it occurs in rolled pieces.

Geographic

* According to some late experiments, tourmaline would seem to contain Boracic acid.

Geographic Situation.

It was first discovered in the 16th century, in the island of Ceylon;—afterwards in Brazil, and since that period in several other countries, as appears from the following enumeration.

Europe.—Langoe near Kragerøe in Norway; in the island of Utön in Sweden; near Freyberg, and at Ehrenfriedersdorf, Dorfschemnitz, in the Saxon Erzgebirge, or Metalliferous Mountains; at Altsattel in Bohemia; in Silesia, Bavaria, Moravia, the Tyrol, Stiria, Switzerland, Austria, Italy, Spain, and France.

Asia.—The red tourmaline occurs in Siberia, Ava, and Ceylon; and several of the other varieties in the same countries of Asia.

Africa.—Island of Madagascar.

North America.—The green, blue, yellow, and red varieties occur in the United States, imbedded in granite: and in primitive rocks in South Greenland.

South America.—Brazil.

Uses.

The green, blue, and brown varieties are sometimes cut and polished, and worn as ornamental stones; but, owing to the muddiness of their colours, are not in high esteem. When set as ring-stones, they are valued more on account of their electrical property, which can be excited by merely holding them to the fire, than for their colours, lustre, or transparency. The white rock-crystals of Catharinenburg, which contain delicate crystals of green tourmaline, as well as those inclosing crystals of actynolite and titanium, are cut and polished, and worn as ornamental stones.

Observations.

Observations.

1. *Distinctive Characters.*—*a.* Between *tourmaline* and *common schorl*. Common *schorl* has but one colour, whereas *tourmaline* has a considerable suite of colours. The fracture of common *schorl* is small-grained uneven; that of *tourmaline* conchoidal: common *schorl* is always opaque, *tourmaline* more or less translucent or semitransparent: common *schorl* generally occurs in distinct concretions, whereas *tourmaline* presents this character very rarely: and we may add, that *schorl* is very often massive and disseminated, but *tourmaline* very seldom.—*b.* Between *tourmaline* and *hornblende*. The colour-suite and crystallizations of this mineral are very different from those of *tourmaline*; *hornblende* has a very distinct cleavage, whereas in *tourmaline*, the cleavage is very rarely seen, and is indistinct; and *hornblende* is not so hard as *tourmaline*.

2. Different varieties of this mineral have received particular denominations. The following are some of these:

Names given to particular varieties of TOURMALINE.

1. Green *Tourmaline*, named *Brazilian Emerald*.
2. Berlin-blue *Tourmaline*, *Brazilian Sapphire*.
3. Indigo-blue *Tourmaline*, *Indicolite*.
4. Honey-yellow *Tourmaline*. *Peridot of Ceylon*.
5. Red *Tourmaline*, *Rubelite*, *Siberite*, *Daou-rite*, *Tourmaline apyré*, *Red Schorl of Siberia*.

3. In the Island of Ceylon, the most frequent varieties are the brown and hyacinth-red, occasionally intermixed with

with those of a yellow, green, and red colour. In Brazil the green and blue are not uncommon: in Spain the principal variety is brown, and in other parts of Europe the dark-brown, approaching to black, is the most frequent variety. The peach-blossom red variety occurs in Moravia; the indigo-blue in the island of Uton in Sweden; and the apple-green and grass-green in dolomite in St Gothard. In the United States the blue, green, yellow and red varieties are met with.

4. The red tourmaline is arranged as a distinct subspecies, under the title *Rubellite*, by Karsten and Steffens; and Karsten and Dandrada describe the indigo-blue variety as a separate species, under the title *Indicolite*.

5. In the Grevillian collection, now in the British Museum, there is a large and fine specimen of red tourmaline, which was presented to Colonel ~~Simms~~ by the King of Ava*; and in the beautiful collection belonging to Baron Racknitz at Dresden, I observed a specimen of this variety nearly an inch in diameter, for which 400 rubles were paid. In Morgenbesser's cabinet at Vienna, there is a prism of red Siberian tourmaline which cost 800 rubles.

Second

* This specimen consists of many crystals, and was valued at £ 500 by the Commissioners who were appointed by Parliament to report on the value of the Greville collection, previously to its being purchased by Government for the British Museum.

Second Subspecies.

Common Schorl*.

Gemeiner Schörl, *Werner*.

Some of the varieties of Basaltes crystallizatus, *Wall.* t. i. p. 333.
—Schwartzter-stangen schorl, *Wid.* p. 279.—Schorl, *Kew.*
vol. i. p. 265.—Sorlo-nero, *Nap.* p. 146.—Tourmaline, *Lam.*
t. ii. p. 295.—Le Schorl noire, *Broch.* t. i. p. 226.—Tourma-
line noire, *Hall.* t. iii. p. 31.—Gemeiner Schorl, *Reuss*, b. ii.
th. i. s. 129. *Id. Lud.* b. i. s. 71. *Id. Suck.* 1r th. s. 217. *Id.*
Bert. s. 193. *Id. Mohs*, b. i. s. 177. *Id. Hab.* s. 33.—Tour-
maline, *Lucas*, p. 51.—Tourmaline schorl, *Brong.* t. i. p. 107.
—Tourmaline, *Brard*, p. 140.—Tourmaline, *Kid.* vol. i. p. 233.
Schorl opaque et noire, *Hall.* Tabl. p. 39.—Gemeiner Schorl,
Steffens, b. i. s. 60. *Id. Hoff.* b. i. s. 617. *Id. Haus.* Handb.
b. ii. s. 641.—Common Schorl, *Aikin*, p. 218.

External Characters.

Its colour is velvet-black, of various degrees of inten-
sity.

It occurs ~~often~~ massive and disseminated, seldom in
rolled pieces, and frequently crystallized, in three, six, and
nine sided prisms, that present acuminations, truncations,
and bevelments, of the same kinds as those that occur in
tourmaline.

The crystals are mostly acicular; often appearing as if
broken, and forming with the apparent fragments a pecu-

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* Adeling says *Schorl* is derived from the old German word *Schor*, im-
pure, or useless, because the schorl met with in the Saxon tin-mines, not-
withstanding its resemblance to that ore in general aspect, does not belong
to it, and is thrown away as useless.

liar kind of fragmented stone or breccia; and are imbedded. The lateral planes are longitudinally streaked, and alternate from shining to glistening.

It occurs in 'distinct concretions of different kinds; rarely coarse and small granular; sometimes thin, or thick, and straight prismatic. Sometimes the prismatic concretions are so thin, that they verge on fibrous; and such varieties are sometimes parallel, but most frequently scopiform diverging fibrous. These prismatic concretions are sometimes again collected into others, which are thick and wedge-shaped.

Internally its lustre is intermediate, between shining and glistening, and is vitreous.

The fracture is intermediate between perfect conchoidal, and small and coarse grained uneven, and inclines sometimes more to the one, sometimes more to the other.

The fragments are indeterminate angular, and somewhat sharp-edged.

It is opaque.

It affords a grey streak.

It is as hard as quartz.

It is very easily frangible.

Specific gravity, 3.092, *Brisson*.—150, *Gerhard*.—3.212, *Kirwan*.—3.0863 to 3.3636, *Haüy*.

Chemical Characters.

Before the blowpipe it melts pretty easily, without addition, into a blackish slag. Melted with borax, it forms a greenish-coloured glass.

Constituent

Constituent Parts.

	Common Schorl from Eibenstock.	• Common Schorl from the Spessart.
Silica,	36.75	36.50
Alumina,	34.50	31.0
Magnesia,	0.25	1.25
Oxide of Iron,	21.0	23.50
Potash,	6.0	5.50
Trace of Oxide of Manganese.		
	<hr/> 98.50	<hr/> 97.75
	<i>Klaproth's Beiträge, b. 5.</i>	
	s. 118, 149.	

Physical Characters.

Exhibits the same electrical properties as tourmaline.

Geognostic Situation.

It occurs in imbedded masses and crystals in granite, gneiss, mica-slate, and clay-slate; as an essential constituent part of topaz-rock, and occasionally intermixed with quartz-rock.

It occurs in veins that traverse clay-slate and other rocks, along with quartz and tinstone, and sometimes also with felspar and mica. In these veins the schorl appears as if broken in pieces, and floating in a base of quartz. It has not been found in any of the secondary or flötz-rock, but occurs in alluvial deposits.

Geographic Situation.

Europe.—Perthshire, Banffshire, Ross-shire, Inverness-shire, Argyllshire, and the Shetland islands; Cornwall; Norway, Sweden, Saxon Metalliferous Mountains (Erzgebirge), Hartz, Bohemia, Franconia, Moravia, Silesia, Suabia, Bavaria, Switzerland, the Tyrol, Hungary, France and Spain.

Asia.—Ceylon, borders of the Lake Baikal, and different parts of the Uralian range.

America.—Greenland, Hudson's Bay, United States, Mexico.

Observations.

1. It differs from *tourmaline* in colour, degree of lustre, fracture, transparency, and distinct concretions; also in its geognostic situation, for *tourmaline* occurs almost always imbedded and in single crystals; on the contrary, *schorl* is usually aggregated, and occurs in beds.

2. The *aphrizit* of D'Andrada is but a variety of *schorl*.

3. Large and beautiful crystals of common *schorl* are found in Spain, the Tyrol, Island of Madagascar, West Greenland; and of late years the United States of America have furnished splendid crystals of this mineral.

GENUS VIII.

GENUS VIII.—CHRYSOLITE.

THIS genus contains one species, viz. Prismatic Chrysolite.

1. Prismatic Chrysolite.

Prismatischer Krisolith, *Mohs*.

Peridot, *Haüy*.

This species is divided into two subspecies, viz. Chrysolite, and Olivine.

First Subspecies.

Chrysolite *.

Krisolith, *Werner*.

Yellowish-green Topaz, Chrysolith, *Cronstedt*, § 46. 5. p. 54.—
Gemma pellucidissima, duritia sexta, colore viridi, subflavo,
in igne fugaci; Chrysolithus, *Wall.* gen. 18. spec. 119. p. 255.
—Krysolith, *Wid.* s. 264.—Chrysolite, *Kirw.* vol. i. p. 262.—
Krysolith, *Estner*, b. ii. s. 122. *Id. Emm.* b. i. s. 26.—Chryso-
lito nobile, *Nap.* p. 127.—Peridot, *Lam.* t. ii. p. 250.—La
Chrysolithe, *Broch.* t. i. p. 170.—Peridot, *Haüy*, t. iii. p. 198.
—Chrysolith, *Reuss*, b. i. s. 49. *Id. Lud.* b. i. s. 60. *Id. Suck-*
1r th. s. 540. *Id. Bert.* s. 138. *Id. Mohs*, b. i. s. 42. *Id. Leon-*
hard, Tabel. s. 1.—Peridot, *Lucas*, p. 74.—Peridot Chryso-
lithe, *Brong.* t. i. p. 440.—Peridot, *Brard*, p. 179.—Chryso-
lith,

* The name *Chrysolite* (χρυσολίθος, *Chrysolithus*, a gold-yellow stone) is of Grecian origin, but was by the ancients applied to the topaz.

lith, *Haus.* s. 98. *Id. Karsten*, Tabel. s. 40.—Chrysolite, *Kid*, vol. i. p. 120.—Peridot, *Häuy*, Tabl. p. 52.—Chrysolith, *Steffens*, b. i. s. 365. *Id. Lenz*, b. i. s. 203.—Harter Peridot, *Oken*, b. i. s. 333.—Krisolith, *Hoff.* b. i. s. 429. *Id. Haus.* Handb. b. ii. s. 680.—Chrysolite, *Aikin*, p. 229.

External Characters.

Its colour is pistachio-green, which sometimes approaches to olive-green, seldom to asparagus-green, and pale grass-green. Very rarely we observe in the same specimen, besides the green, also in a particular direction a pale cherry-red, inclining to broccoli-brown colour.

It occurs in angular pieces, (that appear to be original,) sometimes in roundish pieces which seem to be pebbles, and often crystallized. The primitive figure is a prism of $131^{\circ} 48'$. All the other figures may be traced to this prism. The following are some of the principal varieties of secondary forms.

1. Broad rectangular four-sided prism, in which the lateral edges are truncated. The broader lateral faces are generally cylindric convex. The prism is acuminated with six planes: of these planes, two are set on the broader lateral planes, and the other four on the truncating planes of the lateral edges. The apex of the prism is truncated, fig. 46*, Pl. 3.
2. The preceding figure, but acuminated with eight planes, which are set on the lateral and truncating planes

* Peridot triunitaire, Häuy.

[Subsp. 1. *Chrysolite*.

planes of the prism, and the apex of the prism deeply truncated, fig. 47 *, Pl. 3.

3. The preceding figure, in which the edge between the truncating plane of the apex of the acumination, and the acuminating plane which rests on the smaller lateral plane, is truncated, fig. 48 †, Pl. 3.
4. Very oblique four-sided prism, in which the acuter edges are bevelled, and the edges of the bevelment truncated; and acuminated on the extremities with four planes, which are set on the lateral edges, and the apex of the acumination slightly truncated. This figure is formed from N° 1. when the truncations on the lateral edges increase, until the broader lateral planes disappear. Sometimes the bevelling and acuminating planes are very small, but the truncating planes of the bevelment large, so that the crystal appears like a four-sided table of heavy-spar, bevelled on the terminal planes, or it assumes a reed-like aspect ‡, fig. 49. Pl. 3.
5. Less oblique four-sided prism, in which the obtuse edges are truncated, the acute bevelled, and the bevelment truncated; acuminated on the extremities with eight planes, of which four are set obliquely on the lateral planes of the prism, four straight on the truncated lateral edges. The apex of the acumination truncated ||, fig. 50. Pl. 3.

6. N° 3

* Peridot monostique, Haüy.

† Peridot subdistique, Haüy.

‡ Peridot continu, Haüy.

|| Peridot doublant, Haüy.

6. N° 3. in which the lateral edges in place of being truncated, are bevelled *, fig. 51. Pl. 3.

Some crystals are very thin and reed-like, or table-shaped.

The crystals are middle-sized, small, and all around crystallized.

The external surface of the angular pieces, as also of the crystals, where they have suffered from attrition, are delicate splintery, or scaly and glistening: in unaltered crystals, on the contrary, the broader lateral planes in all the varieties, with exception of N° 4., are deeply longitudinally streaked; but the smaller lateral planes are often smooth, and the acuminating planes are always smooth.

Internally the lustre is splendid and vitreous.

The cleavage is in the direction of the smaller diagonal of the prism.

The fracture is perfect flat conchoidal.

The fragments are indeterminate angular and very sharp-edged.

It is transparent, and refracts double, particularly when viewed through the broader acuminating planes, and the obliquely opposite broader lateral planes of N° 1.

It scratches felspar, and sometimes even quartz.

It is brittle.

It is easily frangible.

Specific gravity, 3.340, 3.420, *Werner*.—3.428, *Haüy*, 3.301, 3.472, *Karsten*.—3.343, *Lowry*.—3.3, 3.5, *Mohs*.

Chemical Characters.

Its colours change, but it does not melt, without addition, before the blowpipe; but with borax, it melts into a transparent green glass.

Constituent

* Peridot quadruplant, *Haüy*.

Constituent Parts.

Silica,	39.00	88.00.	38.00
Magnesia,	43.50	39.50	50.50
Iron,	19.00	19.00	9.50
	<hr/>	<hr/>	<hr/>
	101.50	96.50	100
<i>Klaproth</i> , Beit.		<i>Id. Klap.</i>	<i>Vauquelin</i> .
b. i. s. 110.		s. 107.	

Geognostic Situation.

This mineral has hitherto been found only in a loose state: some mineralogists conjecture that it occurs in veins in serpentine, or greenstone; and also in newer trap rocks.

Geographic Situation.

It is brought to Europe from the Levant, and it is said to occur in Upper Egypt, and on the shores of the Red Sea; and it is alleged to have been detected in trap rocks in Bohemia, and the Isle de Bourbon*.

Uses.

This gem, which has an agreeable colour, and considerable lustre and transparency, is used in jewellery for necklaces, hair ornaments, and for ring-stones, when it is set with a gold foil. It is the softest of the precious stones; hence

* Pliny, who describes it under the name *Topaz*, says that it is found in the island *Topazos* in the Red Sea, and also near the town of *Alabastrum*, near *Thebais* in Upper Egypt.

hence jewels of it become dull on the surface, if not carefully worn and kept*.

Observations.

1. This mineral is characterised by its pistachio-green colour, the other varieties occurring rarely; the fine splintery or scaly surface of the angular pieces; its crystallizations, internal lustre, fracture, inferior hardness, and weight.

2. *Distinctive Characters.*—*a.* Between Chrysolite and *Vesuvian*. If the vesuvian is in rolled pieces, it can be distinguished from chrysolite, by its wanting the fine scaly or splintery surface which characterises that mineral. if in crystals, by their being very slightly longitudinally streaked, having a fine-grained uneven fracture, and resinous internal lustre; whereas the crystals of chrysolite are deeply longitudinally streaked, the fracture is conchoidal, and the lustre is vitreous. A simple chemical distinctive character may be mentioned: vesuvian is fusible before the blowpipe, chrysolite is infusible.—*b.* Between Chrysolite and yellowish-brown and pistachio-green *Tourmaline*. Tourmaline becomes strongly electric by heating, but the chrysolite only by rubbing; tourmaline is harder than chrysolite; the crystallizations of tourmaline are different from those of chrysolite; and tourmaline is heavier than chrysolite.—*c.* Between Chrysolite and *Asparagus-stone* of Werner. *Asparagus-stone* is softer and lighter than chrysolite, and refracts single, whereas chrysolite refracts double.

3. Werner

* Dr Clarke mentions a mass the size of a turkey's egg, which was purchased by the lady of the Russian ambassador at Constantinople, and cut into a necklace and bracelets.

3. Werner is of opinion, that the stone described by the ancients under the name *Yellow Chrysolite*, is not the true chrysolite, but our topaz. The celebrated traveller Bruce, mentions an island in the Red Sea which was said to afford emeralds; but remarks, that the substance he there met with, was scarcely harder than glass. Dr Kid remarks, "May not this have been chrysolite, and this island the Topaz Island mentioned by Pliny?" Romé de Lisle and Born, describe the asparagus-stone of Werner under the name Chrysolite; and other writers have confounded it with Chrysoberyl, and oil-green Beryl.

Second Subspecies.

Olivine*.

• Olivin, *Werner*.

Olivin, *Werner*, Bergm. Journ. 3. 2. s. 56.—Chrysolit en grains irreguliers, *De Born*, t. i. p. 70.—Olivin, *Wid.* s. 261. *Id. Kirw.* vol. i. p. 263. *Id. Emn.* b. i. s. 35.—Crysolito commune, *Nap.* p. 131.—Olivine, *Lam.* t. ii. p. 278. *Id. Broch.* t. i. p. 175.—Peridot granuliforme, *Haüy*, t. iii. p. 205.—Olivin, *Reuss*, b. ii. s. 49. *Id. Lud.* b. i. s. 61. *Id. Suck.* 1r th. s. 556. *Id. Bert.* s. 151. *Id. Mohs*, b. i. s. 45.—Chrysolith Olivin, *Hab.* s. 56.—Peridot granuliforme, *Lucas*, p. 74.—Olivin, *Leonhard*, Tabel. s. 2.—Peridot Olivine, *Brong.* t. i. p. 441.—Peridot granuliforme, *Brard*, p. 179.—Olivin, *Karst.* Tabel. s. 40. *Id. Kid*, vol. i. p. 122.—Peridot granuliforme, et lamelliforme, *Haüy*, Tabl. p. 52.—Olivin, *Steffens*, b. i. s. 363. *Id. Lenz*, b. i. s. 206.—Weicher Peridot, *Oken*, b. i.

* The name *Olivine*, is given to this species on account of its predominating olive-green colour.

b. i. s. 334.—Olivin, *Hoff.* b. i. s. 437. *Id. Haus.* b. ii. s. 681.
Id. Aikin, p. 229.

External Characters.

Its colour is olive-green, which passes on the one side into asparagus-green, on the other into oil-green, and into a colour intermediate between ochre and cream-yellow, and into pale yellowish-brown.

It occurs massive, in grains, in roundish pieces, from the size of a hemp-seed to that of a man's head, which are generally imbedded, and less frequently loose.

When crystallized, which is rarely the case, it is in the form of rectangular four-sided prisms, which are always imbedded.

The massive varieties occur in small and angulo-granular concretions.

Internally the lustre is shining and glistening, and is indeterminate between vitreous and resinous.

An imperfect double cleavage is sometimes discoverable.

The fracture is small-grained uneven, sometimes passing into imperfect small conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

It is translucent, passing into semi-transparent, seldom transparent.

It is hard, but in a lower degree than chrysolite.

It is brittle.

It is easily frangible.

Specific gravity, 3.225, *Werner*.—3.265, *Klaproth*.

Chemical Characters.

It is infusible before the blowpipe without addition; with borax, it melts into a dark-green bead. It loses its colour

colour in nitrous acid, the acid dissolving the iron, which is its colouring ingredient.

Constituent Parts.

	Olivine of Unkel.	Olivine of Karlsberg.
Silica, - -	50.0	52.00
Magnesia, - -	38.50	37.75
Lime, - -	0.25	0.12
Oxide of Iron, - -	12.00	10.75
	<hr/> 100.75	<hr/> 100.62
	<i>Klaproth, Beit.</i>	<i>Id. Klaproth,</i>
	b. v. s. 118.	s. 121.

Geognostic Situation.

It occurs imbedded in basalt, greenstone, porphyry, and lava, and generally accompanied with augite.

Geographic Situation.

Europe.—It occurs in the secondary trap rocks of the Lothians, and other districts in Scotland; and in those of the Hebrides. Sparingly in trap rocks in the north of Ireland*. It is found in Iceland; and on the Continent, in Bohemia, Saxony, Stiria, Austria, Hungary, France, Italy, Spain, &c.

Africa.—Teneriffe; St Helena; Isle de Bourbon.

America.—Greenland; and the Cordilleras of South America.

Observations.

* Greenough.

Observations.

1. *a.* Olivine is distinguished from Chrysolite by its paler green colours, external shape, lower lustre, fracture, distinct concretions, inferior transparency, inferior hardness, and weight.

b. Olivine is nearly allied to Augite: this alliance is not so much a consequence of agreement in external characters, as rather a similarity in geognostic relations. Both species occur in the same kind of rock, and the one seldom without the other; and the large masses and grains of olivine sometimes contain small angular grains of augite; which take, as it were, the place of single distinct concretions,—a fact which shews their mutual affinity. It is distinguished from *Augite* by its paler colours, external shape, kind of lustre, fracture, superior transparency, and its inferior hardness and weight.

c. It is distinguished from *Common Green Garnet*, by its greater transparency, inferior hardness, and weight, and geognostic situation.

2. It frequently decays, or falls into an earth, which much resembles iron-ochre. When it begins to exhibit on its surface iridescent colours, it is a proof of its having already begun to decay.

3. A yellow substance, nearly allied to olivine, occurs in the Siberian meteoric iron.

GENUS IX.

GENUS IX.—AXINITE

THIS Genus contains but one species, viz. Prismatic Axinite.

1. Prismatic Axinite.

Prismatischer Axinit, *Mohs*.

Thumerstein, *Werner*.

Schorl transparent lenticulaire, *Romé de Lisle*, t. ii. p. 353.—Glass-schorl, or Glastein, *Wid.* p. 294.—Thumerstone, *Kirw.* vol. i. p. 273.—Glastein, *Klap.* b. ii. s. 118.—Tumite, *Nap.* p. 158.—Janolite, *Lam.* t. ii. p. 316.—La pierre de Thum, *Broch.* t. i. p. 236.—Axinite, *Haüy*, t. iii. p. 22.—Axinit, *Reuss*, b. ii. th. i. s. 200. *Id. Suck.* 1^r th. s. 230.—Thumerstein, *Bert.* s. 184. *Id. Mohs*, b. i. s. 180. *Id. Lud.* b. i. s. 73. *Id. Hab.* s. 22.—Axinite, *Lucas*, p. 53. *Id. Brong.* t. i. p. 389. *Id. Brard*, p. 138. *Id. Kid*, vol. i. p. 240. *Id. Steffens*, b. i. s. 77. *Id. Haüy*, Tabl. p. 37. *Id. Hoff.* b. i. s. 678. *Id. Haus.* Handb. b. ii. s. 626. *Id. Aikin*, p. 215.

External Characters.

Its most common colour is clove-brown, of various degrees of intensity; from which it passes on the one side into plum-blue, on the other into pearl-grey, ash-grey, and greyish-black †.

It

* The name *Axinite*, from *ἄξιν*, *an axe*, on account of the axe-like shape of the crystals.

† It has sometimes a green colour, owing to intermixed chlorite, and crystals of this colour are alleged to be the most regular.—*Brong.* t. i. p. 390.

It is seldom found massive, often disseminated, but most frequently crystallized.

The primitive form is an oblique four-sided prism, whose bases are parallelograms, with angles of $101^{\circ} 56'$, and $78^{\circ} 50'$, or it is a very flat rhomboid, according to the Wernerian Crystallography. Two of the crystallizations of this species are represented in fig. 51. and 52. Pl. 3.; and the following are the descriptions, according to the Wernerian method :

1. In very flat rhomboids, in which the two opposite acute lateral edges are generally truncated. Fig. 51. Pl. 3.
2. Oblique four-sided table, in which two opposite terminal planes are set on obliquely; the other two bevelled; and two opposite acute angles truncated. The truncating planes are smooth, but the others are streaked. Fig. 52. Pl. 3.

The crystals sometimes intersect one another, forming a kind of cellular aggregation.

The massive varieties occur in curved lamellar distinct concretions, whose surface is shining and streaked.

Externally its lustre is generally splendid; internally, it alternates from glistening to shining, and is vitreous, slightly inclining to resinous.

The fracture is fine-grained uneven; in the translucent varieties it sometimes approaches to splintery; in the transparent varieties, to small and imperfect conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It alternates from perfectly transparent to feebly translucent.

It is harder than felspar, but not so hard as quartz.

It is very easily frangible.

Specific gravity, from 3.213 to 3.2956, *Haüy*—3.295, *Kirwan*.—3.250, *Gerhard*.—3. 3.3, *Mohs*.

Chemical

Chemical Character.

Is easily fusible with ebullition into a bottle-green glass, which by continuance of the heat becomes nearly black.

Constituent Parts.

Silica,	52.70	44.0	50.50
Alumina,	25.79	18.0	16.
Lime,	9.39	19.0	17.
Oxide of Iron,	8.63	14.0	9.50
— of Manganese,	1.0	4.0	5.25
Potash,	-		0.25
	<hr/> 97.51	<hr/> 99.0	<hr/> 98.50

Klaproth, t. 2. p. 126. *Vauquelin*, Jour. d. Mines, n. 23. *Klaproth*, t. v. p. 28.

Geognostic Situation.

This mineral occurs in primitive mountains, in rocks of gneiss, mica-slate, clay-slate and hornblende-rock. The massive varieties occur in beds, the crystallized in veins. In the Saxon metalliferous mountains, where it occurs in beds, it is associated with massive calcareous-spar, common chlorite, magnetic-pyrites, iron-pyrites, arsenical pyrites, copper-pyrites, blende, and probably also with actynolite and hornblende. At Kongsberg in Norway, it occurs along with native silver, galena, slaty glance-coal, and calcareous-spar. In the Felberthal in Salzburg, it occurs in mica-slate; and in the Hartz, along with quartz and asbestos; at Arendal in Norway, along with calcareous-spar, common actynolite, common iron-pyrites, felspar, epidote, and sphene. The axinite from Dauphiny, Savoy, and several other places, occurs in small veins, that traverse gneiss, in which it is generally the uppermost mineral. In these

veins it is associated with crystallized felspar, rock-crystal, asbestos, epidote, octahedrite, mica, and chlorite.

Geographic Situation

Europe.—It occurs in Carrarach-mine, two miles north of St Just's Church in Cornwall *, in a bed in clay-slate, associated with garnet, and common schorl. Upon the Continent of Europe, at Arendal and Kongsberg in Norway. At Thum, near Ehrenfriedersdorf, Schneeberg, and Siebenschlien in Upper Saxony, and at Treseburg in Lower Saxony; also in the Black Forest (Schwartzwald) in Swabia; in the valley of Lauterbrun in the Canton of Berne, the valley of Ferrera in Graubunden, and the valley of Chamouny in Switzerland; at Ayarsun in Guipusco in Spain; and in Dauphiny and Alsace.

Africa.—In Mount Atlas.

Observations.

1. *Distinctive Characters.*—Between axinite and common felspar. Felspar has a different suite of colours from that of axinite: felspar has a distinct cleavage, axinite a compact fracture; felspar does not occur in curved lamellar concretions, as is the case with axinite; felspar is softer than axinite; felspar has a specific gravity of 2.4 to 2.7, axinite 3.21 to 3.29; and felspar melts before the blow-pipe into a white-coloured enamel; axinite to a blackish-coloured glass.

2. The first crystal of axinite was described by Romé de Lisle, but he arranged it with schorl: it was Werner who established it as a distinct species.

3. Werner named it Thumerstone, from Thum in Saxony, where it was first found: Haüy's name Axinite, is derived

derived from the shape of the crystals, which somewhat resembles that of an axe. When first discovered, it was named *Dauphiny-Schorl*, *Glass-Schorl*, and *Violet-Schorl*.

GENUS A.—GARNET †.

THIS Genus contains three species, viz. *Pyramidal Garnet*, *Dodecahedral Garnet*, and *Prismatic Garnet*,

1. *Pyramidal Garnet*.

Pyramidaler Granat, *Mohs*.

This species contains three subspecies, viz. *Vesuvian*, *Egeran*, and *Gehlenite*•

First Subspecies.

Vesuvian †.

Vesuvian, *Werner*.

Idocrase, *Häuy*.

Hyacinth du Vesuve, *Romé de Lisle*, t. ii. p. 291.—*Vulcanischer Schorl*, *Wid.* s. 290.—*Vesuvian*, *Estner*, b. ii. s. 177. *Id. Emm.* b. i. s. 342.—*Hyacinthe*, *Lam.* t. ii. p. 323.—*La Vesuvienne*, *Broch.* t. i. p. 184.—*Idocrase*, *Häuy*, t. ii. p. 574.—*Vesuvian*, *Reuss*, b. ii. th. i. s. 314. *Id. Lud.* b. i. s. 63. *Id. Suck.* 1r th. I 2 s. 197.

• The name *Garnet*, is conjectured to be derived either from *granum*, a grain, this gem occurring often in the granular form; or from *granate*, the pomegranate tree, the flowers of which have a red colour resembling that of the garnet.

† The name *Vesuvian* was given this mineral, from its frequent occurrence at Mount Vesuvius.

s. 197. *Id. Bert.* s. 156. *Id. Mohs*, b. i. s. 68. *Id. Hab.* s. 27.
 —Idocrase, *Lucas*, p. 48. *Id. Brong.* t. i. p. 391. *Id. Brard*,
 128.—Vesuvian, *Kid.* vol. i. p. 252.—Idocrase, *Huüy*, Tabl.
 p. 34.—Vesuvian, *Steffens*, b. i. # 358. *Id. Hoff.* b. i. s. 472.
 —Idocras, *Haus. Handb.* b. ii. s. 622. *Id. Aikin*, p. 224.

External Characters.

Its principal colours are green and brown; the most frequent green colour is blackish-green, less frequent are leek-green, pistachio-green, olive-green, and oil-green; the most frequent brown colour is liver-brown, less frequent varieties are blackish-brown, and reddish-brown. It is rarely of a blue colour.

It occurs massive, disseminated, and in coarse and small granular concretions; but more frequently crystallized.

The primitive form is a pyramid of $129^{\circ} 30'$ and $74^{\circ} 12'$. The following varieties of form can be referred to this pyramid.

1. Rectangular four-sided prism, flatly acuminated by four planes, which are set on the lateral planes; the lateral edges and summits of the acuminations truncated. Fig. 53. Pl. 3.
2. Preceding figure, in which the lateral edges are bevelled, and the edges of the bevelments truncated. Fig. 54. Pl. 3.
3. Preceding figure, in which the acuminating edges are truncated. Fig. 55. Pl. 3.
4. When the four-sided prism, acuminated by four planes, becomes so low, that the acuminating planes touch each other, a flat double four-sided pyramid is formed, in which the summits and the angles on the common base are truncated*.

The

* Professor Beavois observed in Piedmont vesuvian crystals having cylindrical and very deeply longitudinally streaked lateral planes; but these, according to M. Verina, appear to be groups of acicular crystals.

[Subsp. 1. *Vesuvian*.

The crystals are generally short and middle-sized; sometimes all around crystallized, at other times superimposed.

The lateral planes of the prism are longitudinally streaked; but the truncating and terminal planes are smooth.

Externally the crystals are splendid; internally glistening, approaching to shining, and the lustre is vitreo-resinous.

The cleavage is in the direction of the diagonals of the prism, but imperfect.

The fracture is small-grained uneven.

It alternates from translucent to translucent on the edges; and refracts double.

It scratches felspar, but not quartz.

It is brittle, and rather easily frangible.

Specific gravity, 3.409, *Werner*.—3.0882 to 3.409, *Hall*.—3.365 to 3.420, *Klaproth*.—3.4412, *Karsten*.—3.3 to 3.4, *Mohs*.

Physical Characters.

It becomes electrical by friction, but not by heating.

Chemical Characters.

Before the blowpipe it melts without addition into a yellowish and faintly translucent glass.

Constituent

Constituent Parts.

	Vesuvian of Vesuvius.	Of Siberia.
Silica,	35.5	42.
Lime,	33.0	34.
Alumina,	22.25	16.25
Oxide of Iron,	7.5	5.5
Oxide of Manganese,	0.25	
Loss,	1.5	2.25
	<hr/> 100	<hr/> 100

Klaproth, Beit. b. ii. s. 32, & 38.

Geognostic and Geographic Situations.

Europe.—It was first found in the vicinity of Vesuvius, where it still occurs in considerable abundance, in unaltered ejected rocks, composed of granular limestone, mica, hornblende, melanite, garnet, quartz, epidote, felspar, chlorite, and specular iron-ore.

These rocks are supposed to be part of the primitive mass in which that celebrated volcanic mountain is situated; and are probably disposed in beds.

The rare blue variety is found at Souland, in Tellemark, in Norway, along with a hard peach-blossom coloured mineral named *Thulite**.

Other varieties occur in small irregular veins traversing gneiss, in the vicinity of Monte Moro, eastward of Monte Rosa; and in a rock named Testa Ciarva, in the Plain of Musa in Piedmont, in veins traversing serpentine. Beautiful transparent oil-green varieties are found at Corbasiera in Piedmont; brown varieties, in talc-slate in the district

* The *Thulite* Mr Heuland informs me is also found in Greenland.

[Subsp. 1. *Vesuvian*.

strict of Balme in Piedmont*. In large crystals upon Mount St Gothard; and near Pitigliano† in the district of Sienna. In gneiss, along with hornblende, precious garnet, and magnetic ironstone, at San Lorenzo in Spain. In Ireland, (according to my friend and pupil Dr Fitton‡), it occurs at Kilranelagh in primitive country, in a rock composed of garnet, quartz and felspar; also at Donegal, in a rock composed of quartz, granular limestone, and a fibrous substance supposed to be tremolite.

Asia.—It occurs in Kamschatka, at the mouth of the rivulet Achterguda, which flows into the Wilui, in a pale greenish-grey coloured steatite, which contains crystallized magnetic ironstone; also in serpentine, and in a rock composed of chlorite and calcareous-spar‡.

Uses.

At Naples, it is cut into ring-stones, and is sold under various names: the green-coloured varieties are denominated Volcanic Chrysolite; and the brown, Volcanic Hyacinth.

Observations.

1. *Distinctive Characters*.—*a*. Between vesuvian and garnet. The planes of garnet are glistening, or glistening inclining to shining; those of vesuvian splendid: garnet is harder and heavier than vesuvian: the most frequent forms of

* Mr Heuland, and Mr J. Marryat junior, possess magnificent specimens of the oil-green vesuvian. Mr Marryat's collection of Piedmontese minerals is unique.

† Transactions of the Geological Society, vol. i. p. 274.

‡ This variety has been described under the name *Wiluite*.

of garnet, are the garnet dodecahedron and leucite figure, neither of which occur in vesuvian: garnet is not so transparent as vesuvian: lastly, garnet is not so fusible as vesuvian, and yields rather a black scoria than a translucent glass.—*b.* Between vesuvian and *zircon*. The pyramid of zircon is flatter than that of vesuvian, and is much more frequent; and *zircon* is harder and heavier.—*c.* Between vesuvian and *chrysolite*. Chrysolite is distinguished from vesuvian, by colour, form, greater transparency, superior internal lustre and kind of fracture.—*d.* Between vesuvian and *Brazilian tourmaline*. Brazilian tourmaline differs from vesuvian in colour, and by its becoming electrical by heating, which is not the case with vesuvian, this latter mineral showing electrical properties only by friction.

2. It has been described under a variety of names, as Volcanic Schorl, Chrysolite, Hyacinth, and Topaz. Werner first established it as a distinct species, and gave it its present name.

3. The Peridote Idocrase of Bonvoisin, which is found in the Alps of Musa in Piedmont, along with garnet in serpentine, is a variety of vesuvian.

Second Subspecies.

Egeran *.

Egeran, *Werner*.

External Characters.

The colour is reddish-brown, sometimes passing into liver-brown.

It

* *Egeran*, from Eger in Bohemia, where it is found.

[Subsp. 2. Egeran.]

It occurs massive, and sometimes crystallized, in rectangular four-sided prisms, with cylindrical convex lateral planes. The prisms are long, and deeply longitudinally streaked.

It occurs in thin, and very thin distinct concretions, which are scopiform or promiscuous, and collected into large angulo-granular concretions.

Externally it is shining; internally glistening and shining, and lustre vitreous, slightly inclining to resinous.

The cleavage is twofold, in the direction of the sides of the rectangular prism.

The fracture is uneven, passing into small and imperfect conchoidal.

It is feebly translucent on the edges.

It scratches felspar, but not quartz.

It is brittle.

Specific gravity 3.294, *Breithaupt*.

Chemical Character.

Before the blowpipe it melts into a black scoria.

Geognostic and Geographic Situations.

It occurs at Haslau near Eger in Bohemia.

It is generally associated with quartz and calcareous spar, sometimes also with garnet, or with asbestous tremolite, and is contained in a bed of felspar and hornblende, subordinate to mica-slate.

Third

*Third Subspecies.***Gehlenite**

Gehlenit, *Fuchs*, in Brocchi, Über das Thal Fassa.—Stylobat, *Breithaupt*, in Leonhard's Taschenbuch.

External Characters.

Its colours are olive-green inclining to leek-green, oil-green, liver-brown, greenish-grey, and greenish-white. All the colours are muddy.

It occurs crystallized in rectangular four-sided prisms, which are so short as to appear as tables. The planes are rough and dull, or very feebly glimmering.

The crystals are small and very small, and seldom middle sized; are superimposed, or on one another; and sometimes imbedded in calcareous spar.

Internally glistening; often nearly dull, and intermediate between resinous and vitreous.

The cleavage threefold and rectangular; but very imperfect.

The fracture fine splintery.

Is strongly translucent on the edges; or nearly opaque.

It is rather easily frangible.

It is harder than felspar; but not so hard as quartz.

Specific gravity 2.98.

Chemical Characters.

Before the blowpipe it melts into a brownish-yellow transparent glass, which soon becomes opaque and scoriform, when acted on by the interior part of the flame.

Geographic

* *Gehlenite*, in honour of Gehlen the chemist.

Geographic Situation.

It occurs along with calcareous spar in the valley of Fassa in the Tyrol.

2. Dodecahedral Garnet.

This species contains nine subspecies, viz. 1. *Pyreneite*, 2. *Grossulare*, 3. *Melanite*, 4. *Pyrope*, 5. *Garnet*, 6. *Allochroite*, 7. *Colophonite*, 8. *Cinnamon-stone*, 9. *Helvin*.

*First Subspecies.**Pyreneite* *.*Pyreneit*, *Werner*.*External Characters.*

Its colour is greyish-black.

It occurs massive, and crystallized in the form of rhomboidal dodecahedrons.

The crystals are small, all around crystallized, and imbedded.

Externally it is glistening, inclining to shining, and metallic-like.

Internally it is glistening and vitreous.

The fracture is small-grained uneven.

The fragments are indeterminate angular, rather sharp-edged.

It is opaque.

It is hard.

Specific gravity 2.500 ? *Raymond*.

Chemical

* So named from the Pyrenees, where it occurs.

Chemical Characters.

It loses its colour before the blowpipe, intumesces and melts with great ease, into a yellowish-green vesicular enamel.

Constituent Parts.

Silica,	-	-	43
Alumina,	-	-	16
Lime,	-	-	20
Oxide of Iron,	-	-	16
Water,	-	-	4
			99

Vauquelin, Journal des Mines, N. 44. p. 571.

Geognostic and Geographic Situations.

It occurs in primitive limestone in the Pic of Eres-Lids near Bareges in the French Pyrenees. The massive varieties are disposed in thin layers, with limestone; the crystals are imbedded in the same rock.

Observation.

This subspecies was discovered in the Pyrenees by Raymond.

*Second Subspecies.**Grossulare* *.*Grossular, Werner.*

Grossular, Steffens, b. i. s. 93.—*Olyengrün Granat* aus Sibirien, *Klaproth*, b. iv. s. 319. *Id. Sib.*, Tabl. p. 58.—*Grossular,*

* The name *Grossulare* is derived from the [*Ribes*] *grossularia*, or gooseberry, because this mineral resembles some varieties of that fruit in colour and general form.

sular, *Hoff*. b. i. s. 479.—Gemeiner Granat, *Haus*. Handb. b. ii. s. 599.

External Characters.

Its colour is asparagus-green, approaching to mountain-green.

It has been hitherto found only crystallized, and in the following form :

Leucite crystallization ; or the acute double eight-sided pyramid, flatly acuminate on both extremities by four planes ; the acuminate planes set on the alternate edges of the double eight-sided pyramid.

The crystals are middle-sized and small, and are all around crystallized.

The planes of the crystals are smooth.

Externally it is shining ; internally shining, and the lustre is resinous.

The fracture is intermediate between conchoidal and uneven.

It is strongly translucent.

It is hard.

It is rather easily frangible.

Specific gravity 3.351, *Werner*.—3.372, *Klaproth*, 3.600, *Gerhard*.—3.562, *Blöde*.

Chemical Characters.

It melts like garnet before the blow-pipe, and into a brown vesicular bead.

Constituent

Constituent Parts.

Silica,	-	-	44
Lime,	-	-	33.50
Alumina,	-	-	8.50
Oxide of Iron,	-	-	12.
Loss,	-	-	2
			<hr/>
			100

*Klaproth, Beit. b. iv. s. 323.**Cognostic and Geographic Situations.*

It occurs imbedded in small crystals, along with vesuvian, in a pale greenish-grey claystone, near the river Wilui in Siberia; also in the Bannat of Temeswar.

Observations.

1. This garnet was discovered in Siberia in the year 1780, by Counsellor Laxman; and was first mentioned by Pallas, in the fifth volume of the *Neue Nordische Beiträge*.

2. In the centre of some crystals portions of the matrix occur, and these also contain minute grains of the grossular, thus exhibiting appearances of the same nature as those observed in the leucite imbedded in trap-rocks.

*Third Subspecies.***Melanite *.****Melanit, Werner.**

Melanit, *Broch.* t. i. p. 191. *Id. Reuss*, b. ii. th. i. s. 136. *Id.*

Suck. 1^{re} th. s. 194. *Id. Bert.* s. 162. *Id. Mohs*, b. i. s. 76. *Id.*

Lud.

*

* *Melanite*, from *melas*, black, the only colour of this mineral.

Lind. b. i. s. 64.—Grenat Melanite, *Brong.* t. i. p. 397.—Schlackiger Granat, *Karsten*, Tabel.—Grenat noire émarquiné, *Haiiy*, Tabl. p. 33.—Melanit, *Steffens*, U. i. s. 92.—Melanit, *Hoff.* b. i. s. 488. *Id.* *Haus.* b. ii. s. 664. *Id.* *Aikin*, p. 226.

External Characters.

Its colour is velvet-black, which sometimes inclines to greyish-black.

It occurs in roundish grains, but most frequently crystallized.

Its regular form is the rhomboidal dodecahedron, truncated on all the edges.

It is all around crystallized.

The crystals are middle-sized and small.

The surface of the grains is rough and uneven, that of the crystals is sometimes rough and uneven, but more frequently smooth and shining, sometimes approaching to splendid. Internally it is shining, inclining to glistening; and is resino-vitreous.

The fracture is flat and imperfect conchoidal; sometimes with traces of a threefold cleavage parallel with the acuminating planes of the dodecahedron.

The fragments are indeterminate angular and sharp-edged; sometimes rhomboidal.

It is opaque.

Is as hard as quartz.

It is rather easily frangible.

Specific gravity 3.730, *Klaproth*.—3.7, *Hausmann*.—3.729—3.774, *Brcithaupt*.—3.791, *Vauquelin*.

Constituent

Constituent Parts.

Silica,	-	-	35.5
Alumina,	-	-	6.
Lime,	-	-	32.5
Oxide of Iron,	-	-	25.25
Oxide of Manganese,			0.4
Loss,	-	-	0.35
			100

Klaproth, Beiträge, b. v. p. 168.

Geognostic and Geographic Situations.

It is found in a rock at Frescati near Rome, which contains besides melanite, also felspar, vesuvian, and basaltic hornblende. At Monte Somma near Naples it occurs in granular limestone; and in grains in the basalt of Bohemia; and in the iron-mines of Swappavara at Tornea in Lapmark.

Observations.

1. *Distinctive Characters.*—*a.* Between melanite and precious garnet. Red is the only colour of precious garnet, and it exhibits several varieties of it; whereas velvet-black is the only colour of melanite: In precious garnet, the suite of crystals extends from the garnet or rhomboidal dodecahedron to the double eight-sided pyramid terminated by four planes, or the leucite form; whereas the melanite has but one figure, which is the rhomboidal dodecahedron truncated on its edges. The internal lustre of precious garnet is vitreous, that of melanite resinous-vitreous; precious garnet alternates from transparent to translucent, melanite is opaque: precious garnet scratches quartz more readily

readily than melanite; and the specific gravity of precious garnet is 4.2, that of melanite only 3.7.—*b*. Between melanite and *common garnet*. The colours of common garnet are green* and brown, colours that do not occur in melanite: common garnet occurs most commonly massive, melanite never; the suite of crystallizations of common garnet is the same as in precious garnet, therefore very different from melanite: the fracture of common garnet is uneven, that of melanite conchoidal: common garnet occurs in granular concretions, which is never the case with melanite; and common garnet is more or less translucent, but melanite is always opaque.

Fourth Subspecies.

Pyrope *.

Pyrop, *Werner*.

Pyrop, *Broch*. t. ii. p. 498. *Id. Lud*. b. i. s. 67. *Id. Hab*. s. 28. *Id. Mohs*, b. i. s. 97. *Id. Lucas*, p. 265.—*Grenat Pyrope*, *Brong*. t. i. p. 369.—*Pyrop*, *Karst*. *Tabl*.—*Grenat, rouge de feu, granuliforme*, *Häuy*, *Tabl*. p. 33.—*Pyrop*, *Steffens*, b. i. s. 94. *Id. Hoff*. b. ä. s. 521. *Id. Haus*. *Handb*. b. ii. s. 596. *Id. Aikin*, p. 227.

External Characters.

Its colour is dark blood-red, which, when held between the eye and the light, falls strongly into yellow †.

VOL. I.

K

It

* It used to be considered a variety of precious garnet, and was generally known under the name of *Burmian Garnet*, from its occurring in Bohemia in great beauty and perfection. Its name is of Grecian origin, from *πύρε* and *πέτρα*, from the blood or fire red colour it exhibits when held opposite the light.

† *Pyrope* and *garnet*, when cut and polished, are easily distinguished from *spinel* and *sapphire*, by the dark tinge which their colours possess.—*Häuy*, t. ii. p. 545.

It occurs in small and middle-sized roundish and angular grains.

Its lustre is splendid, and vitreo-resinous.

The fracture is small, and perfect conchoidal.

The fragments are indeterminate angular, and sharp-edged.

* It is transparent, and refracts double.

It scratches quartz more readily than precious garnet.

Specific gravity 3.718, *Klaproth*.—3.714,—3.719, *Breithaupt*.

Constituent Parts.

Silica,	-	-	40.0
Alumina,	-	-	28.50
Magnesia,	-	-	10.00
Lime,	-	-	3.50
Oxide of Iron,	-	-	16.50
————* Manganese,	-	-	0.25
Acid of Chrome,	-	-	2.00
Loss,	-	-	1.25
			100.75

Klaproth, B. v. s. 171.

The magnesia which it contains distinguishes it in a chemical view from precious garnet. The richness of its red colour is conjectured to be owing to the chromic acid.

Geognostic Situation.

It occurs imbedded in trap-tuff, wacke, claystone and serpentine.

Geographic Situation.

In trap-tuff at Ely in Fifeshire; and in claystone in Cumberland. Meronitz in Bohemia, imbedded in trap-tuff and wacke,

wacke; also in alluvial soil, formed from these rocks by decomposition, where it is associated with sapphire, zircon, melanite, olivine, and iron-sand. At Zöblitz, in Saxony it is imbedded in serpentine.

Use.

This beautiful gem is employed in almost every kind of jewellery, and is generally set with a gold foil. The best way of cutting it is *en cabochon*, with a row or two of small facets, round the girdle of the stone. When cut in steps, the colour appears too deep, but when *en cabochon*, it displays a bright and rich blood-red. The small and very small grains are pounded, and used in place of emery, in cutting softer stones.

Observations.

1. *Distinctive Characters.*—Between pyrope and *precious garnet*. . Precious garnet possesses a considerable colour suite; pyrope but one colour, which is blood-red: precious garnet occurs crystallized, which is never the case with pyrope: the internal lustre of precious garnet is shining; that of pyrope is splendent: precious garnet exhibits several varieties of fracture; pyrope is only conchoidal; precious garnet refracts single; pyrope double: precious garnet is softer than pyrope, and has a higher specific gravity: and, lastly, pyrope contains 10 *per cent.* of magnesia, an earth that does not occur in precious garnet; and it is more difficultly fusible

Fifth Subspecies.

Garnet *.

THIS subspecies is divided into two kinds, viz. Precious Garnet and Common Garnet.

First Kind.

Precious Garnet.

Edler Granat, *Werner*.

Carbunculus, *Plin.* Hist. Nat. xxxvii. 7. 1. 25. (in part.)—*Granatus*, *Wall.* t. i. p. 262.—*Grenat*, *Romé de Lisle*, t. ii. p. 316. *Id. Born*, t. i. p. 147.—*Oriental Garnet*, *Kirw.* vol. i. p. 258.—*Edler Granat*, *Emm.* b. i. s. 358.—*Almandin*, *Karst.* Tabel.—*Grenat*, *Häuy*, t. ii. p. 540.—*Le Grenat noble*, *Broch.* t. i. p. 193.—*Almandin*, *Reuss*, b. i. th. i. s. 69.—*Edler Granat*, *Lud.* b. i. s. 64.—*Almandin Granat*, *Suck.* 1^r th. s. 173.—*Edler Granat*, *Bert.* s. 271. *Id. Mohs*, b. i. s. 79.—*Grenat*, *Lucas*, p. 46.—*Grenat noble*, *Brong.* t. i. p. 395.—*Grenat*, *Brard*, p. 123.—*Garnet*, *Kid*, vol. i. p. 147.—*Grenat*, *Häuy*, Tabl. p. 33.—*Edler Granat*, *Steffens*, b. i. s. 84. *Id. Hoff.* b. i. s. 492.—*Almandine*, *Haus.* Handb. b. ii. s. 595. *Id. Aikin*, p. 225.

External Characters.

All the colours of this gem are dark-red, which generally fall into blue; the principal colour is columbine-red, which

* This gem was named *ar-pa* by the Persians, and by the Romans *Carbunculus*, carbuncle, (from *carbo*), because it was said to shine in the dark like a glowing coal. But the ancients included under this *Carbunculus* also varieties of ruby and spinel. The name *Garnet* is of comparatively modern date, being first mentioned by Albertus Magnus.

which passes into cherry-red, brownish-red, and blood-red, and it appears even to pass into hyacinth-red.

It occurs very seldom massive, sometimes disseminated, and in angular pieces, but most commonly in roundish grains, and crystallized, in the following forms:

1. Rhomboidal dodecahedron, which is the primitive figure. Fig. 56. Pl. 3. *
2. Rhomboidal dodecahedron, truncated on all the edges †. Fig. 58. Pl. 3.
3. Acute double eight-sided pyramid, in which the lateral planes of the one are set on the lateral planes of the other, and the summits deeply and flatly acuminated with four planes, which are set on the alternate lateral edges. It is the form of the mineral named Leucite; hence is often named the Leucite form. Fig. 57. Pl. 3. ‡.
4. The preceding figure, in which the eight acute angles, formed by the meeting of the acuminating and lateral planes, and the alternate angles on the common basis, and all the edges are truncated. Fig. 60. Pl. 3.
5. Rectangular four-sided prism, acuminated with four planes set on the lateral edges.

The surface of the grains is generally rough, uneven, or granulated; that of the crystals is almost always smooth, only the lateral and acuminating planes of the leucite form are delicately streaked in the direction of the longer diagonal.

The

* Garnet prism, Haüy.—Romé de Lisle, t. 2. p. 323. var. 1, Pl. 4. 106.

† Grenat emarginé, Haüy.—Romé de Lisle, p. 324. var. 2. Pl. 4. fig. 107.

‡ Grenat trapezoidal, Haüy.—Romé de Lisle, p. 327. var. 111,—109.

The rhombohedral dodecahedrons occur from very large to very small; the other forms are middle-sized, small, and very small.

The crystals are always all around crystallized, and the grains imbedded; they are generally single, seldom collected in groupes.

Externally the lustre of the crystals and grains is glistering; internally it is shining, bordering on splendid; and is vitreous, inclining slightly to resinous.

The fracture is more or less conchoidal, which sometimes passes into coarse and small-grained uneven. Rarely an imperfect sixfold cleavage is to be observed*.

The fragments are indeterminate angular, and more or less sharp-edged.

It sometimes occurs in lamellar distinct concretions†.

It alternates from completely transparent to translucent, according to the kind of fracture‡, and refracts single.

It scratches quartz, but does not affect topaz.

It is brittle.

It is rather difficultly frangible.

Specific gravity, 4.230, *Werner*.—4.085, *Klaproth*.—4.352, *Karsten*.—4.188, *Brisson*.—4.1888, *Haüy*.—3.964, —4.142, *Breithaupt*.

Constituents

* The conchoidal variety has the greatest, and the coarse-grained uneven the least lustre.

† The distinct concretions occur more frequently in the garnet of Greenland.

‡ The transparent varieties are often impure in *oxide of iron*.

§ After Zircon, it is the heaviest of the precious stones. #A.B.

Constituent Parts.

Silica, 35.75	Silica, 36	Silica, 39.66
Alumina, 27.25	Alumina, 22	Alumina, 19.66
Oxide of Iron, 36.00	Lime, 3	Black oxide of
Manganese, 0.25	Oxide of Iron, 41	Iron, 39.68
Loss, 0.75		Oxide of Man-
	102	ganese, 1.80
100	Vauquelin.	100.80
Klaproth, b. il. s. 26.		Berselius, in Afhand- lingar, vol. iv. p. 385.

Chemical Character.

Before the blowpipe it melts pretty easily into a black scoria or enamel.

Geognostic Situation.

It occurs imbedded in primitive rocks; most frequently in mica-slate, chlorite-slate, and gneiss, less frequently in granite, quartz-rock, hornblende-rock, primitive greenstone and serpentine. Primitive metalliferous beds, such as those of ironstone and of cobalt, occasionally contain crystals of precious garnet.

Geographic Situation.

Europe.—In Scotland, it occurs in Perthshire, Aberdeenshire, Inverness-shire, Ross-shire, Sutherland, the outer range of the Hebrides, as Harris and Lewis; and in several of the Shetland islands, as Mainland and Unst.

Upon the Continent of Europe, it occurs in Norway, Lapland, Sweden, Saxony, Bohemia, Silesia, Switzerland, Stiria, the Tyrol, Salzburg, Hungary, and France.

Asia.—It is found in many parts of Siberia, also in Armenia, Pegu, and Ceylon.

Africa.

Africa.—Ethiopia and Madagascar.

America.—Greenland, United States, Mexico, Brazil, and Chili.

Use.

This beautiful gem is not so highly valued at present as it was a century ago. The larger kinds are used as ring-stones, and, after cutting and polishing, are set either *au jour*, or are provided with a silver or violet-blue foil *. When facet-cut, on account of the deepness of its colours, it is generally formed into thin tables, which are frequently hollowed out on their under-side. Cut stones of this description, when skilfully set with a bright silver foil, have been sold as rubies. The smaller kinds are used for necklaces, ear-drops and bracelets. Many fine pieces of engraving have been executed on this mineral. In the National Museum in Paris, there are several beautiful engraved garnets, and among others, a very fine head of Louis XIII. One of the finest engraved garnets is that executed by the celebrated artist Calvi, in the possession of Lord Duncannon, which represents the Dog Sirius.

Crystals sometimes occur the size of a fist, or even larger: these are cut into small vases, which are very highly valued, particularly if they are free of flaws, and possess a good colour, and considerable degree of transparency.

Some varieties of garnet, when cut in a particular manner, reflect a star of four rays. They are much prized, and are sometimes sold under the name *Adventurine garnet*.

The

* The silver-foil is mentioned by Pliny, in his *History Nat.* lib. 37.

The coarser kinds are used as emery, for polishing other minerals; for this purpose, they are previously repeatedly heated and quenched in water, reduced to powder in an iron-mortar, and, lastly, diffused through water, poured into other vessels, and allowed to settle, in order to obtain an uniform powder. In this state it is known to artists by the name of *red emery*.

This gem is successfully imitated by the following composition, which, when well and judiciously cut and polished, equals the garnet in lustre and transparency:

Purest white glass, 2 ounces.

Glass of antimony, 1 ounce.

Powder of Cassius, 1 grain.

Manganese, 1 grain.

The garnets of commerce are imported from Brazil, Ceylon, and Pegu. Those of Pegu are the most highly valued.

Observations.

1. *Distinctive Characters.*—Between precious garnet and common garnet. Brown and green are the most common colours of common garnet, but red is the only colour of precious garnet: the lustre of common garnet is resinous and glistening, but that of precious garnet is vitreous, slightly inclining to resinous, and is shining inclining to splendent: the fracture of common garnet is fine-grained uneven, that of precious garnet conchoidal: common garnet is only translucent, whereas precious garnet is semi-transparent, and transparent: common garnet occurs in granular concretions, precious garnet never: common garnet is usually small, and very small, seldom middle-sized, whereas precious garnet is sometimes large, and often middle-sized: common garnet has a specific gravity of 3.7, that

that of precious garnet is 4.2.—*b.* Between dodecahedral garnet and *dodecahedral zircon*. If the dodecahedral garnet be viewed as a six-sided prism, the dodecahedral zircon will appear as a four-sided prism; and in the garnet, the adjacent planes meet under angles of 120° , but in the zircon under angles of $124^{\circ} 12'$, and $117^{\circ} 54'$.

2. Karsten considers precious garnet as a distinct species, and places it in his system between zircon and garnet, under the name *Almandine*; he considering it as identical with the *alabandicus* (Pliny, Hist. Nat. lib. xxxvii. sect. 25.) of the ancients.

3. The precious garnet is sometimes named Syrian Garnet, not from Syria, but from Syrian, a town in Pegu, now destroyed, where it was met with in great beauty. Some naturalists maintain that Syrian is from *soranus*, which signifies a red stone, and not from Syrian.

Second Kind.

Common Garnet.

Gemeiner Granat, Werner.

Le Grenat commun, *Broch.* t. i. p. 198.—Granat, *Reuss*, b. ii. th. i. s. 79.—Gemeiner Granat, *Suck.* 1^r th. s. 181. *Id. Bert.* s. 160. *Id. Lud.* b. i. s. 65. *Id. Mohs*, b. i. s. 85.—Grenat commun, *Brong.* t. i. p. 396.—Grenat brun, rougeatre, verdatre, &c. *Haiiy*, Tabl. p. 33.—Gemeiner Granat, *Steffens*, b. i. s. 87. *Id. Hoff.* b. i. s. 503. *Id. Haus.* b. ii. s. 599.—Common Garnet, *Aikin*, p. 225.

External Characters.

Brown and green are its most common colours. Of brown it occurs liver-brown, yellowish-brown, and reddish-brown,

brown; and of ~~green~~, blackish-green. From liver-brown it passes into olive, pistachio, blackish and leek green, and from this even into mountain-green: from yellowish-brown it passes into isabella yellow: from reddish-brown into a middle colour between hyacinth and blood red: from blackish-green into greenish-black. In many specimens different colours occur together.

It occurs most commonly massive, but never in grains or angular pieces: Sometimes crystallized, and possesses all the figures of the precious garnet.

The crystals are never above middle-sized, and seldom occur imbedded and single, but are generally superimposed and aggregated in druses.

The surface of the rhomboidal dodecahedron is smooth, but the lateral and acuminating planes of the leucite form are streaked in the direction of the longer diagonal.

It occurs in small, and fine angulo-granular distinct concretions, which sometimes pass into coarse granular.

The lustre is sometimes shining, sometimes glistening, very rarely splendid.

Internally the lustre is glistening, seldom shining, and is intermediate between resinous and vitreous.

The fracture is fine-grained uneven, sometimes slightly inclining to imperfect conchoidal, or to splintery.

The fragments are indeterminate angular, and not particularly sharp-edged.

It is more or less translucent; the black nearly opaque.

It is a little softer than precious garnet.

It is rather difficultly fragibile.

Specific gravity, 3.757 to 3.754, *Werner*.—3.668, 3.664, *Karsten*.—3.699, *Hausmann*.

Chemical Character.

It melts more easily before the blowpipe than precious garnet.

Constituent Parts.

Silica,	-	-	38.0
Alumina,	-	-	20.6
Magnesia,	-	-	00.0
Lime,	-	-	31.6
Iron,	-	-	10.5
			<hr/>
			100

Vauquelin in Haüy's
Traité, t. ii. p. 543.

Geognostic Situation.

It occurs massive or crystallized, in druſy cavities, in beds, in mica-slate, clay-slate, chlorite-slate, and primitive-trap, where it is accompanied by different ores, as magnetic ironstone, ~~red~~ ironstone, magnetic pyrites, common iron-pyrites, arsenical pyrites, copper-pyrites, vitreous copper-ore, blende and galena, and by various earthy minerals, as actynolite, hornblende, epidote, augite, coccolite, tremolite, and schaalstone. It sometimes also forms the whole mass of beds. It also occurs imbedded in serpentinc. Humboldt mentions it as occurring in veins in Mexico.

Geographic Situation.

Europe.—According to Dr Fitton and Mr Stephens, it
occurs

occurs at Kilranelagh and Donegal in Ireland*. Upon the Continent, it occurs at Arendal and Drammen in Norway, where it is accompanied with granular limestone, common quartz, felspar, augite, hornblende, mica, axinite, and apatite; less frequently with epidote, coccolite, scapolite, and fluor-spar. At Kemi, in Russian Lapland, in chlorite-slate. In Sweden, it occurs in beds in mica-slate at Langbannshytta and Sunnerskog; it is also found at Dannemora, Fahlun, and Garpenberg, in Sweden. It occurs in several places in the Saxon Erzgebirge, as at Berggieshübel, along with brown blende, calcareous-spar, and copper-pyrites; at Breitenbrun, with quartz, common actynolite, and magnetic ironstone; and at Geier, along with quartz, hornblende, common iron-pyrites, and magnetic ironstone, also mixed with quartz, brown blende and copper-pyrites; at Hohenstein, Kupferberg, Presnitz, &c. in Bohemia; Moravia; in the Boberthal in Silesia, in a bed along with calcareous-spar, actynolite, quartz, malachite, and copper and iron pyrites; at Dobschau in Hungary, in dodecahedral crystals, imbedded in serpentine. The ejected masses of Monte Somma, near Vesuvius, which, as formerly mentioned, are compounds of granular limestone, mica, felspar, vesuvian, &c. contain common garnet. Sometimes it occurs in small imbedded crystals, sometimes in massive portions of a reddish-brown or hyacinth-red colour, disposed in granular concretions, which occasionally pass into crystals. The crystals are generally of a hyacinth-red colour, and transparent. In the massive varieties, imbedded crystals of vesuvian are sometimes met with. The reddish-brown and hyacinth-red garnets, which are intermediate between precious and common garnet,

* Transactions of the Geological Society, vol. i.

net, occur in beds along with actynolite, and other minerals, in Carinthia, Stiria, Bayreuth, also near Disentis in Switzerland.

Asia.—New Holland.

Use.

On account of its easy fusibility and richness in iron, it is frequently employed as a flux in smelting rich iron-ores, and as an addition to poor ores. In some countries it is named Green Iron-ore, and Green Iron-garnet. It is seldom cut or polished for ornamental purposes, but is occasionally used by lapidaries in place of emery for cutting minerals.

Observations.

1. It is distinguished from the *precious garnet* by colour, degree of transparency, lustre, kind of fracture, distinct concretions, druses, aggregation of crystals, specific gravity, occurring in beds, and very rarely imbedded.

2. The mineral named *Topazolite* by Bonvoisin, and which is found at Musa in Piedmont, is a variety of garnet intermediate between *precious* and *common*, but more inclined to the *precious*. The *Hyacinth Garnet* is also a variety of common garnet.

Sixth Subspecies.

Allochroite*.

Allochroit, *Werner*.

Allochroit, *Dandrada*, Journ. de Phys. t. 51. p. 235. *Id. Broch.* t. ii. p. 552. *Id. Reuss*, b. ii. th. ii. s. 478. *Id. Lud.* b. ii. s. 159. *Id.*

* The name *Allochroite* given to this mineral is derived from the Greek, (*αλλος* and *χρως*), and refers to its change of colour before the blowpipe.

Id. Suck. 1^r th. s. 716. *Id. Bert.* s. 163. *Id. Lucas*, p. 330. *Id. Brong.* t. i. p. 401. *Id. Brard*, p. 399.—Splittriger Granat, *Karst. Tabel.*—Allochroit, *Hauy*, Tabl. p. 37. *Id. Steffens*, b. i. s. 98. *Id. Hoff.* b. i. s. 512.—Dichter Granat, *Haus. Handb.* b. ii. s. 601.—Allochroit, *Aikin*, p. 226.

External Characters.

Its most frequent colours are greenish-grey and yellowish-grey; and both incline much to brown, and therefore incline sometimes to liver-brown, sometimes to olive-green, and pass into a colour between asparagus and oil green. Sometimes several colours occur together.

It occurs massive.

Externally it is glimmering; internally glimmering, rarely glistening, and the lustre is resinous.

The fracture is sometimes small-grained, uneven; sometimes even, or even passing to flat conchoidal.

The fragments are indeterminate angular, and rather blunt-edged. •

It is feebly translucent on the edges.

It gives sparks with steel, but does not scratch quartz.

It is rather easily frangible.

Specific gravity 3.575, *Dandrada*.—3.58, *Brard*.—3.50, *Brongniart*.—3.637, *Blöde*.

Chemical Characters.

According to Vauquelin, it is fusible without addition, before the blowpipe, into a black, smooth, and opaque enamel. It melts readily with phosphoric salts: if allowed to cool slowly, its colour is first reddish-yellow, next green, and, lastly, a muddy yellowish-white colour.

Constituent Parts.

Silica,	-	35.	37.
Lime,	-	30.5	30.
Alumina,	-	8.	5.
Oxide of Iron,	-	17.	18.5
Carbonate of Lime,	-	6.	
Oxide of Manganese,	-	3.5	6.25
Loss,	-		3.25
		<hr/>	<hr/>
		100	100
<i>Vauquelin</i> , in Lucas, Tabl.			<i>Rose</i> , in Karsten,
p. 30.			Tabel. 33.

Geognostic and Geographic Situations.

It has hitherto been found only in Viuf's iron-mine near Drammen in Norway, where it is associated with calcareous spar, reddish-brown garnet, and magnetic ironstone.

Observations.

1. This mineral was first particularly described and named by Professor Schumacher of Copenhagen, and M. Dandrada.

2. It is distinguished from *common garnet*, the only mineral with which it could be confounded, by its lighter colours, inferior lustre and transparency, general appearance of the fracture, inferior hardness and weight, and by its never occurring crystallized, or in distinct concretions.

Seventh

Seventh Subspecies.

Colophonite, or Resinous Garnet.

Kolophonit, *Simon*, in Journ. f. d. Chem. & Phys. iv. 3. 405.—
Pechgranat, *Karst.* Tabel. s. 32.—Grenat resinite, *Haiiy*,
Tabl. p. 33.—Kalophonit, *Haus.* Handb. b. ii. s. 603.—Colo-
phonite, *Aikin*, p. 226.

External Characters.

Its colour is yellowish-brown, which passes into brown-
ish-black, hyacinth-red, oil-green, and olive-green.

It occurs massive, in angulo-granular concretions, which
are easily separable; and crystallized in rhomboidal dode-
cahedrons, either perfect, or truncated on the edges.

The surface of the crystals appears as if melted.

Internally it is shining; externally splendid.

The lustre is resino-adamantine.

The fracture is imperfect conchoidal.

It is translucent; or only translucent on the edges.

Specific gravity, 4.0, *Simon*.

Constituent Parts.

Silica,	-	-	37.00
Oxide of Iron,	-	-	7.50
Alumina,			13.50
Lime,	-	-	29.00
Magnesia,	-	-	6.50
Oxide of Manganese,			4.75
Oxide of Titanium,			0.50
Water,	-	-	1.00
			<hr/>
			99.75

Simon, in Journ. de Chem. et Phys. iv. 3. 410.

Geognostic and Geographic Situations.

It occurs in beds of magnetic ironstone, which are subordinate to gneiss, at Arendal in Norway; and in talc-slate at Salvagnengo in Piedmont*. It is also found in the Island of Ceylon†.

Observations.

The *Succinite* of Bonvoisin is a variety of Colophonite.

Eighth Subspecies.

Cinnamon Stone.

Kanelstein, *Werner*.

Essonite, *Hauy*.

Hiacint, *Mohs*, Journ. des Mines, n. 130. p. 139.—Kanelstein, *Klap.* in Karst. Tabel.; also in Beit. b. v. p. 138. *Id. Hauy*, Tabl. p. 62. *Id. Steffens*, b. i. s. 97. *Id. Hoff.* b. i. s. 417.—Cinnamon-stone, *Aikin*, p. 227.—Essonite, *Hauy*, Traité des Pierres Precieuses, p. 50.

External Characters.

Its principal colour is intermediate between hyacinth-red and orange-yellow, and passes sometimes into the one, sometimes into the other. It also occurs yellowish-brown and honey-yellow. When held between the eye and the light, and at a distance from the eye, it is orange-yellow, but when held near the eye, the colour is yellow, without mixture of red.

It

* Heuland.

† Bournon.

It occurs massive, and in granular distinct concretions.

Internally it is shining, approaching to glistening; and the lustre is resinous-vitreous.

It is said that an indistinct cleavage is sometimes visible, indicating an oblique prism of $102^{\circ} 40'$ *.

The fracture in every direction is rather imperfect, and flat conchoidal.

The fragments are indeterminate angular, and very sharp-edged.

It is transparent and semitransparent; but it is generally so impure and full of cracks, that faultless specimens rarely occur. It refracts single.

It is softer than garnet, but harder than quartz.

It is brittle.

It is rather difficultly frangible.

When cut, it feels somewhat greasy.

Specific gravity is 3.602 to 3.640, *Mohs* and *Haüy*.

Chemical Characters.

Before the blowpipe it fuses into a blackish-brown enamel.

Constituent Parts.

Silica,	-	-	38.8
Alumina,	-	-	21.2
Lime,	-	-	31.25
Oxide of Iron,	-	-	6.5
Loss,	-	-	2.25

100

Klaproth, *Beit. b. v. s.* 168.

L 2

Geognostic

* If this observation prove correct, then cinnamon-stone will form a distinct species.

Geognostic and Geographic Situations.

It is found in alluvial deposits, and associated with quartz, tabular spar, and ironstone, in gneiss, in the Island of Ceylon*.

Use.

It is cut as a precious stone, and, when free of flaws, is of considerable value.

Observations.

1. *Distinctive Characters.*—*a.* Between cinnamon-stone and *pyrope*. The only colour of *pyrope* is blood-red; but cinnamon-stone has several colours, and none of them are distinct blood-red; *pyrope* scratches quartz more readily than cinnamon-stone: cinnamon-stone occurs in granular concretions, which is not the case with *pyrope*: *pyrope* has not the greasy feel which is observed in cut and polished cinnamon-stone; *pyrope* is heavier than cinnamon-stone; and we do not observe in *pyrope* the numerous rents and flaws that occur in cinnamon-stone.—*b.* Between cinnamon-stone and *vesuvian*. *Vesuvian* has a different colour-suite from cinnamon-stone: *vesuvian* occurs crystallized; cinnamon-stone is not crystallized: the internal lustre of *vesuvian* is vitreo-resinous, and the fracture small-grained uneven; whereas that of cinnamon-stone is resino-vitreous, and the fracture conchoidal.

2. *Quisist* distinguishes two sorts of hyacinth; one whose specific gravity is but 3.6, and is fusible; another which is infusible, and has a specific gravity of 4.3. The first is evidently the cinnamon-stone; the other the hyacinthine zircon.

3. This gem is placed here at present, until its characters are better ascertained.

Ninth

* For this interesting observation we are indebted to Dr Davy.

*Ninth Subspecies.***Helvine*.****Helvin, Werner.**

Helvin, Friesleben's Beiträge zur Mineralogischen Kenntniss von Sachsen, b. i. s. 126.

External Characters.

Its most frequent colour is wax-yellow, which approaches to pale oil-green; rarely to siskin-green.

It occurs disseminated, sometimes in small granular concretions, and crystallized in small tetrahedrons, which are perfect or truncated on the angles.

The crystals are imbedded, or rest upon each other.

Internally it is glimmering or shining.

Externally it is vitreous; internally it inclines to resinous.

It sometimes displays an imperfect cleavage.

The fracture is small-grained uneven.

The crystals are strongly translucent.

It is softer than quartz, but harder than felspar.

It is brittle.

Specific gravity, 3.2, 3.3.

Chemical Characters.

It melts easily before the blowpipe into a blackish-brown glass.

Geognostic

* The name *Helvine* is derived from the Greek word $\epsilon\lambda\eta$, and refers to its colour.

Geognostic and Geographic Situations.

It occurs along with slate-spar, brown blende, fluor-spar, and chlorite, in beds subordinate to gneiss, near Schwarzenberg in Saxony.

Observations.

We still want a satisfactory description of this mineral. It appears to be nearly allied to garnet; hence it is placed in this part of the System.

3. Prismatic Garnet or Grenatite.

Prismatischer Granatit, *Mohs*.

Granatit, *Werner*.

Staurotide*, *Haiiy*.

Grenatite, *Saussure*, § 1900. *Id. Lam.* t. ii. p. 290. *Id. Broch.* t. ii. p. 406.—Staurotide, *Haiiy*, t. iii. p. 93.—Stauroolith, *Reuss*, b. i. th. i. s. 196.—Grenatit, *Lud.* b. i. s. 66. *Id. Suck.* 1^{re} th. s. 227. *Id. Bert.* s. 289. *Id. Mohs*, b. i. s. 94.—Stauroolith, *Hab.* s. 34.—Staurotide, *Lucas*, p. 58. *Id. Brong.* t. i. p. 402. *Id. Brard*, p. 151.—Staurolite, *Kid*, vol. i. p. 251. *Id. Haiiy*, Tabl. p. 43.—Stauroolith, *Steffens*, b. i. s. 191.—Staurotide, *Hoff.* b. i. s. 515. *Id. Haus. Handb.* b. ii. s. 629. *Id. Aikin*, p. 189.

External Characters.

Its colour is dark reddish-brown, which sometimes inclines to reddish-brown.

It

* The name *Stauroolith* given to this mineral by some mineralogists, is borrowed from the Greek words σταυρος, a cross, and λίθος, a stone, and refers to the cross-form of some of its crystals.

It occurs only crystallized, and all the varieties of form which it exhibits may be reduced to a prism of $129^{\circ} 30'$.

The following are the principal varieties of secondary forms.

1. Very oblique four-sided prism, truncated on the acuter lateral edges; or it may be named an *unequiangular six-sided prism*. Fig. 61. Pl. 3.
2. The preceding figure, acutely bevelled on the extremities; the bevelling planes set on the obtuse lateral edges, and the edge of the bevelment truncated. Fig. 62. Pl. 3.
3. Twin-crystal, formed by two perfect six-sided prisms crossing each other at right angles. Fig. 63. Pl. 3.
4. Twin-crystal, formed by two perfect six-sided prisms crossing each other obliquely. Fig. 64. Pl. 3.

The crystals are small and middle-sized; all around crystallized, and therefore originally imbedded.

The surface of the crystals is rough and glistening, and seldom smooth and shining, passing into splendid.

Internally the cleavage is shining and splendid; that of the fracture glistening and glimmering, with a resino-vitreous lustre.

The cleavage is in the direction of the smaller diagonal of the prism.

The fracture is small-grained uneven, which sometimes approaches to small conchoidal.

The fragments are indeterminate angular, and not very sharp-edged.

It is often opaque, sometimes translucent, and very rarely semitransparent.

It is hard; scratches quartz feebly.

It is brittle, and easily frangible.

Specific

Specific gravity, 3.286, *Hauy*.—3.510, 3.765, *Klaproth*.—3.3, 3.8, *Hausmann*.—3.287, 3.338, *Breithaupt*.—3.3, 3.8, *Mohs*.

Chemical Character.

Infusible before the blow-pipe.

Constituent Parts.

	From Morbihan.	St Gothard.	St Gothard.
Alumina,	44.	52.25	41.
Silica,	33.	27.	37.5
Lime,	3.84		
Oxide of Iron,	13.	18.5	18.25
Oxide of Man-			
ganese,	1.	0.25	Magnesia, 0.5
Loss,	5.16	2.	2.75
	<hr/> 100	<hr/> 100	<hr/> 100
<i>Vanq. Jour. des Min.</i>	<i>Klap. Bullet. des</i>	<i>Klap. ibid.</i>	
<i>N° 53.</i>	<i>Scien. de la Soc.</i>		
	<i>Phil. t. i. p. 171.</i>		

Geognostic Situation.

The geognostic relations of this mineral are nearly the same with those of precious garnet, with this difference, that precious garnet occurs in a greater variety of rocks. It has been hitherto found only imbedded in mica-slate, talc-slate, clay-slate, and sometimes in gneiss, and very generally accompanied with kyanite and precious garnet.

Geographic Situation.

Europe.—It occurs in clay-slate near Ardonald, between Keith and Huntly in Aberdeenshire; in a micaceous rock at the

the Glenmalur lead-mines in the county of Wicklow in Ireland *. Upon the Continent of Europe, it occurs in the Tyrol; in Switzerland, as at St Gothard, imbedded in mica-slate, with kyanite and precious garnet; on the north side of the Glacier of Gries in the Vallais, in mica-slate; and in the Piora Alp, also in mica-slate; Transilvania; at St Jago di Compostella in Gallicia in Spain; in Brittany, and other places in France.

America.—It occurs in different places in the United States, as near Baltimore in Maryland, imbedded in mica-slate along with kyanite; in Pennsylvania in mica-slate; in Connecticut in cross crystals along with garnets in mica-slate, and in granite with kyanite; and in Maine in mica-slate *.

Observations.

1. *Distinctive Characters.*—Between grenatite and *precious garnet*. The red colours of precious garnet are more or less intermixed with blue, those of grenatite with brown: precious garnet exhibits a suite of crystallizations, extending from the rhomboidal dodecahedron to the leucite form; grenatite occurs in the form of a particular oblique four-sided prism, and its various derivative forms: precious garnet is harder and heavier than grenatite: and, lastly, precious garnet is fusible before the blowpipe; grenatite is infusible.

2. It is more nearly allied to precious garnet and pyrope than to common garnet.

GENUS XI

* Dr Fitton, in Geological Transactions, vol. i. p. 275.

† Cleaveland's Mineralogy, p. 203.

GENUS XI.—GADOLINITE.

THIS genus contains but one species, viz. Prismatic Gadolinite.

1. Prismatic Gadolinite *.

Prismatischer Gadolinit, *Mohs*.

Gadolinit, *Karsten*.

Gadolinit, *Geyer*, in V. Crell's Chem. Annal. 1788, b. i. s. 229.
—Gadolin, in K. Sv. Acad. n. Handl. 1794, 11.—Gadolinite,
Haüy, t. iii. p. 141. *Id. Reuss*, b. ii. th. ii. s. 7. *Id. Karst.*
Tabel. s. 22. *Id. Haüy*, Tabl. p. 47. *Id. Hoff.* b. iii. s. 308.
Id. Haus. Handb. b. ii. s. 608. *Id. Aikin*, p. 194.

External Characters.

Its colours are velvet-black, sometimes greenish-black, less frequently brownish-black, and very rarely hyacinth-red.

It occurs massive, and disseminated; the massive varieties are sometimes composed of granular or prismatic concretions; the surfaces of which have frequently a whitish or bluish aspect, and vary from glistening to dull. It very rarely occurs crystallized; and its primitive figure appears to be an oblique four-sided prism, in which the obtuse angle is nearly 110° . This prism sometimes occurs with six lateral planes.

Internally it is shining, and the lustre is resinous, inclining to vitreous.

The fracture is generally conchoidal; seldom uneven.

It

* This species was named *Gadolinite*, in compliment to Dr Gadolin, the discoverer.

It is faintly translucent on the thinnest edges, and then it appears blackish-green.

It is harder than felspar, but softer than quartz.

Its streak is greenish-grey.

It is brittle.

It is difficultly frangible.

When pure, it does not appear to affect the magnet.

Specific gravity 4.2230, *Geyer*.—4.0280, *Gadolin*.
4.2370, *Klaproth*.—4.0497, *Hauy*.—4, to 4.2, *Mohs*.

Chemical Characters.

It intumesces very much before the blowpipe, and at length melts into an imperfect slag, which is magnetical. It loses its colour in nitric acid, and gelatinises.

Constituent Parts.

	Gadolinite from Finbo.	Gadolinite from Broddbo.
Silica,	25.80	24.16
Yttria,	45.00	45.93
Oxide of Cærium,	16.69	16.90
Oxide of Iron,	10.26	11.34
Volatile matter,	0.60	0.60
	<hr/> 98.35	<hr/> 98.93

Berzelius in *Afhandlingar*, vol. xiv. p. 217.

Geognostic and Geographic Situations.

It occurs, along with yttrotantalite, at Ytterby near Waxholm in Roslagen, in beds of a coarse granular red felspar, which are situated in mica-slate; at Finbo, near Fahlun, also in Sweden, in a coarse granular granite, along with pyrophyllite and tinstone. In both places the gadolinite is invested with an ochre-yellow earthy crust, which appears to be hydrate of iron. This mineral is said to have been discovered in the Island of Bornholm, and in syenite rocks in Finland.

GENUS XII.—IOLITE

THIS genus contains one species, viz. Prismato-Rhomboïdal Iolite.

Prismato-Rhomboïdal Iolite.

Iolith, *Werner*.

Iolith, *Karst. Tabel.*—Iolithe, *Hauy*, Tabl. p. 61, & 221.—Dichroïte, *Cordier*, Journ. des Mines, t. 25. p. 129.—Iolith, *Steffens*, b. i. s. 369. *Id. Hoff.* b. i. s. 589.—Dichroït, *Haus.* b. ii. s. 659.—Iolite, *Aikin*, p. 194.

External Characters.

Its colour is intermediate between violet-blue and blackish-blue. When viewed in the direction of the axis of the crystals, the colour is dark indigo-blue; but perpendicular to the axis of the crystals, pale brownish-yellow.

It occurs massive, disseminated, in pebbles or rolled pieces, and rarely crystallized.

1. Perfect equiangular six-sided prism.

2. Six-sided prism, truncated on the lateral edges.

The crystals are small, and their surface is rough and dull.

Internally it is glistening, and sometimes shining, and the lustre is vitreous.

The cleavage is imperfect, four-fold, and in the direction of the lateral and terminal planes of the six-sided prism.

The fracture is small-grained uneven, and sometimes small and imperfect conchoidal.

The fragments are indeterminate angular and sharp-edged.

It

* *Iolite*, from *ios*, a violet, and refers to its violet-blue colour.

It is translucent in the direction of the axis of the crystal, and transparent at right angles to it. It refracts double.

It scratches quartz, but with difficulty.

It is easily frangible.

Specific gravity 2.560, *Cordier*.—2.7, *Haüy*.—2.541, *L. Gmelin*.

Chemical Characters.

It melts with difficulty before the blowpipe, into a very pale greenish-grey enamel. The same result is obtained when melted with borax and carbonate of soda.

Constituent Parts.

Silica,	-	-	43.6
Alumina,	-	-	37.6
Magnesia,	-	-	9.7
Potash?	-	-	1.0
Oxide of Iron,	-	-	4.5
———— Manganese, a trace.			

Leopold Gmelin. 99.5

Geognostic and Geographic Situations.

It is found at Orijarvi, near Abo in Finland*; at Bodenmais in Bavaria; in the country of Salzburg; at Granatillo near Nijar, in Spain, imbedded in an aggregate of quartz, precious garnet, mica and felspar, which is included in basalt; and in a bed of trap-tuff in the Bay of San Pedro, also in Spain. Large rolled pieces are found in Siberia. Gicsecké met with it imbedded in felspar, in North Greenland, and in mica in South Greenland†. Rolled pieces or pebbles of iolite are brought from the Island of Ceylon.

Use.

It is cut, polished, and worn as a gem.

Observations.

* Heuland.

† In Heuland's magnificent collection, there are crystals of Iolite from Greenland two inches and a half in length, and one inch and a half in breadth.

Observations.

1. Iolite is characterised by its colour, crystallization, cleavage, hardness and weight.

2. It is distinguished from *sapphire* (with which it has been confounded) by colour, inferior lustre, cleavage, inferior transparency, hardness and weight. Its colour, inferior transparency and hardness, distinguish it from beryl and emerald.

3. It is the *sapphire d'eau* of collectors.

4. Werner describes a mineral under the name *Peliom*, which appears to be but a variety of the prismato-rhomboidal Iolite.

GENUS XIII. QUARTZ *.

THIS genus contains two species, viz. Rhomboidal Quartz and Indivisible Quartz †.

1. Rhomboidal Quartz.

Quartz, *Werner*.*

Rhombodrischer Quartz, *Mohs*.

This species contains fourteen subspecies, viz. 1. Amethyst, 2. Rock Crystal, 3. Milk Quartz, 4. Common Quartz, 5. Prase, 6. Cats-eye, 7. Fibrous Quartz, 8. Iron Flint, 9. Hornstone,

* The name *Quartz* is of German origin, and appears to have been formed from the sound which pieces of this mineral emit when rubbed against each other or any other hard bodies.

† All the subspecies of what is called *rhomboidal quartz*, have a rhomboidal cleavage, or pass into those varieties that possess it. The subspecies of *indivisible quartz*, have no cleavage, or cannot be divided or split in the direction of natural folia.

9. Hornstone, 10. Flinty Slate, 11. Flint, 12. Calcedony, 13. Heliotrope, 14. Jasper.

First Subspecies.

Amethyst *.

This subspecies is divided into two kinds, viz. Common *Amethyst*, and Thick Fibrous *Amethyst*.

First Kind.

Common *Amethyst*.

Gemeiner *Amethyst*, *Werner*.

Gemeiner *Amethyst*, *Reuss*, b. ii. th. i. s. 205. *Id. Lud.* b. i. s. 74. *Id. Suck.* 1r th. s. 280. *Id. Bert.* s. 225. *Id. Mohs*, b. i. s. 193.—*Amethyst-Quartz*, *Hab.* s. 4. *Id. Karst.* Tabel.—*Quartz-hyalin Amethyste*, *Brong.* t. i. p. 279.—*Quartz-hyalin Violet*, *Huüy*, Tabl. p. 25.—*Amethyst*, *Steffens*, b. i. s. 110.—Gemeiner *Amethyst*, *Hoff.* b. ii. s. 3.—Stänglicher Bergkrystal, *Haus.* b. ii. s. 380.—*Amethyst*, *Aikin*, p. 176.

External Characters.

Its principal colour is violet-blue, of all degrees of intensity. It passes on the one side from dark violet-blue, through plum-blue into clove-brown, and a particular kind of brownish-black; on the other side, from pale violet-blue through pearl-grey, ash-grey, greyish-white, greenish-white, olive-green, into pistachio-green †, which latter is uncommonly rare.

In

* The name *Amethyst*, which is of great antiquity, is derived from the Greek *αμethystος*, from *α* and *μεινω*, it being supposed to possess the power of preventing intoxication. Indeed, it was worn as an amulet for that purpose.

† The green varieties are the chrysolite of some authors.

In the massive varieties, several colours occur together, and these are disposed in stripes, or fortification-wise.

Besides massive, it occurs in rolled pieces, and in angular pieces.

The massive varieties are commonly in distinct concretions, which are straight and thick prismatic, obliquely transversely streaked, and when free at the extremities, shoot into the pyramidal form.

These concretions are generally intersected by others which are lamellar, and fortification-wise bent: and the colour delineations are arranged in the direction of these lamellar concretions.

Sometimes the prismatic concretions, when they are very short, (which is very seldom the case), approach in shape to coarse granular concretions.

The most frequent regular figure is

1. A rather acute simple six-sided pyramid. It very seldom occurs in the form of a
2. Double six-sided pyramid, in which the lateral planes of the one are set on the lateral planes of the other; and this is either
 - a. Perfect, or
 - b. Truncated on the common basis. By the increase of this truncation it passes into a
3. A six-sided prism, acuminated with six planes. Sometimes the edges between the acuminating and lateral planes are deeply truncated, as in fig. 65. Pl. 3.

The crystals occur always in druses, and the simple pyramids are side by side, but the double are superimposed on each other.

The crystals are middle-sized, and small.

Externally

[Subsp. 1. *Amethyst*,—1st Kind, Common *Amethyst*.

Externally the crystals are smooth, and alternate from splendid to glistening.

It alternates from translucent to transparent.

It is harder than felspar, but not so hard as emerald.

Internally it is splendid, shining, or approaching to glistening, according to the fracture; and the lustre is vitreous.

The fracture is perfect conchoidal, or imperfect conchoidal, which sometimes passes into uneven and coarse splintery.

It is brittle.


It is rather easily frangible.

Specific gravity 2.632, deep-blue, *Lowry*.—Dark violet-blue from Ceylon 2.781, *Karsten*.—Violet-blue from Saxony 2.750, *Werner*.

Chemical Characters.

Lampadius exposed it for four hours to the strongest heat of a wind furnace, when it suffered no other change than the loss of its colour, and about one and a quarter *per cent.* of its weight*. According to Eherman, when exposed to a stream of oxygen gas, it loses its colour, and melts into a transparent bead.

Constituent Parts.

Silica,	-	97.50
Alumina,	-	0.25
Oxide of Iron,	-	0.50
Trace of Manganese.		
		
		98.25

Rose, *Karsten's Tabell.* s. 23.

* Lampadius, *Samml. pract. chem. Abhandl.* b. i. s. 225.

Geognostic Situation.

"It occurs, in agate-balls in amygdaloid, greenstone, and porphyry, and in veins in primitive and secondary rocks. In the agate balls, it is associated with layers of calcedony, carnelian, flint, and other quartzose minerals, and is usually the uppermost layer of the series. When it occurs in veins, it is associated either with ores of particular kinds, or with agate, or with fibrous amethyst. It occurs also in rolled pieces in alluvial country.

Geographic Situation.

Europe.—In veins and drusy cavities in the secondary or floetz greenstone of Fifeshire, particularly in those varieties that occur in the vicinity of Burntisland; in amygdaloid near Montrose; in amygdaloid and greenstone in the Hill of Kinnoul, near Perth, and in many other parts of Scotland. Near Cork in Ireland.

It occurs in the floetz or secondary trap rocks of Iceland, and the Faroe Islands.

Upon the Continent of Europe, it occurs at Dannemora, in Sweden; in the Clausthal and other parts of the Hartz; at Annaberg, Kunnersdorf, &c. in Upper Saxony; Bohemia; Sillesia; Bavaria; Stiria; Salzburg; Carniola; Switzerland; Hungary; Transilvania; Spain; and France.

Asia.—At Catharinenburg, Nertschinsk, Mursinska, and other places in Siberia; Canbay in India; Persia; and the Island of Ceylon.

America.—Guanoque in Mexico; and in the United States.

Uses.

The most highly valued amethysts are those brought from the continent of India, and the Island of Ceylon. The next in esteem are the Brazilian. Formerly the Saxon and Bohemian amethysts were highly prized in Turkey, and were exported by the way of Venice to Constantinople. At present, very beautiful varieties are found at Catharinenburg in Siberia; near the town of Vique in Murcia in Spain; and sometimes in the Val-Louise in the High Alps.

When the colour is deep and pure, and uniformly diffused, and the transparency is considerable, it forms a gem of great beauty. It is cut into necklaces, ear-drops, and bracclets; but as it is difficult to find a number of perfect stones with the same tint of colour, such pieces of jewellery are very much valued. One of the finest necklaces of this gem in England is said to be in the possession of the Queen. Amethyst is sometimes cut as a ring-stone, and then it appears to much advantage when set round with diamonds. Pale-coloured stones require the assistance of a blue foil. It should be set in gold rather than in silver, as the yellow colour forms a more agreeable contrast with it than the white. When the colour is irregularly diffused, jewellers expose it for a short time, in a mixture of sand and iron-filings, to a moderate heat, by which it is rendered more uniform. When it is wished to conceal the want of uniformity of the tint of colour, jewellers are in the practice of cutting many facets on the stone. A red or reddish-brown colour may be given to amethyst, by inclosing it in a piece of charcoal, igniting it, and allowing it to consume slowly.

The massive varieties, when sufficiently compact, which is not always the case, owing to the easily separable prismatic concretions, are cut into snuff-boxes, and other ornamental articles.

The ancients wore this gem in the form of seal-stones, of which many are preserved in cabinets.

In the Royal Library at Paris there are many fine engraved amethysts; one of the largest is that on which is represented the bust of Trajan; another of great beauty, with the figure of an Achille Cytharide. It was also, when ornamented with figures of the sun or moon, used as an amulet against poison.

Observations.

1. *Distinctive Characters.*—*a.* Between amethyst and rock-crystal. The colour-suite of amethyst does not agree with that of rock-crystal: amethyst occurs principally in the pyramidal form: whereas rock-crystal is generally prismatic: the fracture of amethyst is imperfect conchoidal or splintery; that of rock-crystal is perfect conchoidal: rock-crystal has sometimes a distinct cleavage, which is not the case with amethyst; the lustre of amethyst is lower than that of rock-crystal: the crystals of amethyst do not attain the same magnitude as rock-crystals: amethyst is not so perfectly transparent as rock-crystal: and, lastly, amethyst occurs in prismatic concretions, a form very seldom assumed by rock-crystal; and in lamellar concretions, a form never observed in rock-crystal.—*b.* Between amethyst and rose or milk quartz. The colour-suites of the two minerals are very different: rose quartz occurs only massive, whereas amethyst occurs both massive and disseminated; and more frequently crystallized than massive: the lustre of

of rose quartz is shining and vitreo-resinous; but that of amethyst extends from splendent to glistening, and is vitreous: rose quartz is translucent, approaching to semitransparent: amethyst alternates from semitransparent to transparent.

Second Kind.

Thick Fibrous Amethyst.

Dickfasriger Amethyst, *Werner*.

Dickfasriger Amethyst, *Reuss*, b. ii. th. i. s. 210. *Id. Mohs*, b. i. s. 148.—*Fasriger Quartz*, *Steffens*, b. i. s. 125.—*Fasriger Amethyst*, *Hoff*, b. ii. s. 10.

External Characters.

It has generally a pretty dark violet-blue colour, which, when pale and light, borders on pearl-grey, and from this latter passes into milk and yellowish white.

It occurs only massive and in rolled pieces, never in crystals.

It occurs in thin prismatic concretions, which are collected into large angulo-granular concretions, that incline to wedge-shaped.

Internally its lustre is glistening and vitreous.

The fracture is imperfect conchoidal, and sometimes splintery, and fine-grained uneven.

The fragments are indeterminate angular or wedge-shaped, and are sharp-edged.

It is generally translucent; some varieties incline to semitransparent.

It agrees in the remaining characters with the preceding kind.

Geognostic Situation.

It is found in agate veins, and is generally accompanied with common amethyst. When both kinds occur together in the same vein, the fibrous always adheres to the wall.

Geographic Situation.

Nearly the same as the former.

Observations.

1. The absence of regular forms, the low degree of lustre, the distinct concretions, the inferior transparency, and the frequently occurring white colour, characterize this kind of amethyst, and distinguish it from the other.

2. It is distinguished from *fibrous quartz* by colour, coarse-granular concretions, and its occurrence with common amethyst.

3. The older mineralogists, when they distinguished fibrous amethyst from common amethyst, named it *princ d'amethyste*, because when both kinds occurred together, the common always rested upon the fibrous.

Second Subspecies.

Rock or Mountain Crystal *.

Bergcrystal, *Werner*.

Crystallus, *Plin. Hist. Nat. xxxvii. Ed. Bip. v. 397.*—Quartzum pellucidum cristallizatum, *Wall. p. 226.*—Cristal de roche, *Romé*:

* Formerly this gem was simply named *Chrystal*, an appellation derived from the Greek, (*κρυος*, cold, and *εσθλαδις*, to freeze,) signifying a body congealed

Romé de Lisle, t. ii. p. 70.—Bergcrystal, *Wern. Cronst.* p. 111. *Id. Wid.* p. 296.—Mountain Crystal, *Kirw.* p. 241.—Bergcrystal, *Emm. b. i.* p. 217. *Id. Estner*, b. ii. s. 318.—Quarzo, *Nap.* p. 170.—Quartz, *Lam.* t. ii. p. 119.—Le Cristal de Roche, *Broch.* t. ii. p. 243.—Quartz, *Häuy*, t. ii. p. 406.—Berg Krystal, *Reuss*, b. ii. s. 212. *Id. Lud.* b. i. s. 75, 76.—Edler Quarz. *Suck.* 1st th. s. 284. *Id. Bert.* s. 253.—Berg Crystal, *Mohs*, b. i. s. 200–220. *Id. Hab.* s. 4.—Quartz hyalin, *Lucas*, p. 32. *Id. Brong.* t. i. p. 273. *Id. Brard*, p. 90.—Transparent Quartz, *Kid*, vol. i. p. 195.—Quartz hyalin, *Häuy*, Tabl. p. 24.—Berg Crystal, *Steffens*, b. i. s. 105. *Id. Hoff.* b. ii. s. 12.—Edler Berg Krystal, *Haus. Handb.* b. ii. s. 378.

External Characters.

Its principal colour is white; brown occurs often, but yellow is much less frequent. It very rarely occurs snow-white, more frequently greyish-white, which passes into pearl-grey and blue; further yellowish-white, yellowish-grey, pale ochre-yellow, which sometimes inclines to wine-yellow, yellowish-brown, clove-brown, which is sometimes so dark that it approaches to brownish-black, sometimes inclines to red, and nearly to hyacinth-red. It is often iridescent, particularly the white varieties.

It occurs very seldom massive: often in rolled pieces, most frequently in crystals. The primitive figure, or that
to

gealed by cold, because the ancients believed that rock-crystal was formed in the same manner as ice, and that it was water hardened by cold, but in a higher degree than in common ice. When it was afterwards found that many minerals, and even artificial substances, occurred in equally regular forms with what they called Crystal, this word by degrees changed its signification, and was applied to all minerals, or chemical productions having regular forms. This subspecies of quartz was then named *Crystallus montanus*; hence the English name Rock-crystal, and the French Cristal de roche.

to which all the others can be reduced, is a rhomboid of $94^{\circ} 15'$, and $85^{\circ} 45'$. The following are the principal varieties of secondary forms, which can be traced back to this rhomboid.

1. Equiangular six-sided prism, rather acutely acuminate on both extremities by six planes, which are set on the lateral planes *. Fig. 66. Pl. 4.
 2. When the prism becomes shorter, a double six-sided pyramid is formed, in which the lateral planes of the one are set on the lateral planes of the other, and the remains of the prism form a truncation on the common basis; or the truncation is entirely wanting †. Fig. 67. Pl. 4.
 3. N^o 1. in which the alternate angles formed by the meeting of the acuminating and lateral planes are truncated ‡. Fig. 68. Pl. 4.
 4. N^o 1. in which all the angles formed by the meeting of the acuminating and lateral planes are truncated ||. Fig. 69. Pl. 4.
 5. The prism is sometimes so broad, that it resembles a rectangular four-sided table, in which the terminal planes are bevelled §.
 6. N^o 2. in which three alternate planes in each pyramid become larger than the others, and thus a figure approaching to the cube is formed
7. N^o 1.

* Quartz-hyalin prisiné, Haüy.—Romé de Lisle, t. ii, p. 82. var. 3. Pl. 6. fig. 28.

† Quartz-hyalin dodecaédre, Haüy.—Romé de Lisle, p. 70. Pl. 6. fig. 19.

‡ Quartz-hyalin rhombifère, Haüy.—Romé de Lisle, p. 37. Pl. 6. fig. 38.

|| Quartz-hyalin plagiedre, Haüy.

§ Quartz-hyalin comprimé, Haüy.—Romé de Lisle, p. 85. var. 4. Pl. 6. fig. 29. & 30.

7. N^o 1. in which the lateral planes converge towards one extremity*.
8. An acute simple six-sided pyramid.
9. N^o 1. in which the alternate and unconformable lateral planes converge towards both extremities of the prism.
10. An acute double three-sided pyramid; originates from the preceding figure.

The proportional size both of the lateral and acuminate planes vary so much, as to render it at first sight somewhat difficult to determine the form of the crystal.

The crystals are from uncommonly large to small; but are most frequently middle-sized and large. The prisms are in general larger than the pyramids†.

The crystals are seldom singly imbedded, more frequently attached by one extremity, or by a lateral plane, also variously intersecting each other, and forming druses. Sometimes twin-crystals occur, and these are formed by one crystal penetrating another longitudinally.

The blunt-edged pieces and the balls have a rough surface. The lateral planes of the six-sided prism, and the planes in the other figures that correspond to these, are transversely streaked; but the acuminate planes are smooth. Sometimes the crystals are invested with a rough translucent crust of quartz.

It

* Romé de Lisle, p. 126. var. 12. Pl. 6. fig. 36.

† In the Alps of Switzerland, prisms measuring from two to three feet in length, and from four to seven feet in circumference, have been met with.—Baumer's *Naturgeschichte des Mineralreiches*, th. 1. s. 244. In the Museum of Natural History in Paris, there is a fragment of a rock-crystal, of so great a size, that it is conjectured the original crystal to which it belonged must have weighed more than a thousand pounds.—Pujoulx, *Mineralogie des Gens du Monde*, p. 131.

It very rarely occurs in granular and prismatic distinct concretions *.

Externally, the crystals are generally splendid or shining.

Internally, they are splendid and vitreous.

A cleavage is sometimes observed, the folia of which are parallel with the planes of a double six-sided pyramid of $133^{\circ} 48'$, $103^{\circ} 20'$. Of these folia three are more easily detected than the others, and these are parallel with the planes of the primitive rhomboid.

The fracture is almost always perfect conchoidal.

The fragments are indeterminate angular, and very sharp-edged.

It is generally transparent †, sometimes semitransparent or translucent; it refracts double, but feebly.

It scratches felspar, but does not affect topaz.

It is rather easily frangible.

Specific gravity 2.650, rock-crystal from Madagascar, *Brisson*.—2.605, clove-brown crystal, *Karsten*.—2.888, snow-white transparent, from Marmerosch, *Karsten*.—2.5813, *Huüy*.

Physical Characters.

When two pieces are rubbed against each other, they become phosphorescent, and exhale an odour like that of the electric fluid.

Chemical

* The rare variety in prismatic concretions is one of the links which connects rock-crystal with amethyst.

† In transparent crystals, we generally find the basis or point of adherence nearly opaque.

Chemical Characters.

It is completely infusible before the blowpipe, but, when exposed to a stream of oxygen gas, it melts into a nearly transparent bead. Coloured rock-crystal, if carefully exposed to a gentle heat, loses its colour, but retains its transparency.

Constituent Parts.

Silica,	99 $\frac{3}{4}$
Trace of ferruginous	
Alumina.	
	<hr/>
	100

Bucholz, Gehlen's Journ. 1808, p. 150.

It appears from this analysis, that rock-crystal is an anhydrous silica; other chemists maintain that it contains one or two *per cent.* of moisture.

Geognostic Situation.

1. Although rock-crystal occurs more frequently, and in more numerous geognostic relations than amethyst, yet it is not the most common subspecies of quartz. It appears most frequently, and in the largest and most transparent crystals, in primitive rocks, where it occurs in beds, veins, and large drusy cavities.

These veins often contain large drusy cavities. In the valley of Chamouni, and other districts in Switzerland, in searching for rock-crystals, the principal symptom is the quartz veins in the granite or gneiss. When a vein is discovered, the miner moves only in its line of direction, striking with a hammer, which he continues until a hollow sound

is heard ; here he stops, breaks into the cavity underneath, and finds the rock-crystal.

In the year 1720, a magnificent cavity was opened in a quartz vein in the Grimsel, in the Canton of Berne. The vein which led to the cavity was three feet wide, but the cavity was eighteen feet wide, and one hundred and twenty feet deep, and lined with numerous beautiful rock-crystals. Many of them were one hundred weight, others four or five hundred weight, and even six or eight hundred weight. In other mountains in the Alps, cavities have been opened, containing rock-crystals, weighing upwards of fourteen hundred weight, and measuring in diameter three and a half feet, in length two and a half, and each lateral plane one and a half feet broad. In the Royal Museum in Paris there is a groupe of rock-crystals, weighing three hundred and twenty-five pounds, from the Fischbach in the Vallais ; and belonging to the same magnificent collection, there is a hexahedral prism of transparent rock-crystal, which, on account of its enormous weight, could not be placed in the gallery of the Museum.

The drusy cavities, as well as the other parts of these veins, contain other minerals besides rock-crystal. Thus in Switzerland, France and Scotland, they contain also adularia, common felspar, epidote, chlorite, and calcareous spar ; and in Siberia and other countries, topaz, beryl, and mica. In these veins we very seldom meet with ores, and when they do occur, it is but in small quantities ; and almost the only species hitherto observed, are specular iron-ore, iron-pyrites, and octahedrite.

In other situations, however, it is associated with considerable variety and abundance of ores, and not only in veins, but also in beds. Thus in Hungary, Transilvania, Saxony, and other countries, it occurs in veins along with
galena

galena or lead-glance, blende, copper-pyrites, and iron-pyrites; and in beds in the tin formation of Zinnwald.

These are its principal geognostic relations in primitive mountains; and there, it may be added, it occurs more frequently and abundantly in granite, gneiss and mica-slate, than in other rocks of that class.

It occurs rarely in secondary rocks, and principally in limestone, marl and greenstone.

It may also be noticed, that rock-crystal forms one of the constituent parts of the variety of granite named *graphic granite*.

2. Various substances are found inclosed in rock-crystal: Thus it occasionally contains cavities, which are either wholly or partially filled with air, water, or petroleum; when the cavity is partially filled with water or petroleum, the air-bubble, or space unoccupied by the water, is visible in moving the crystal in different directions. The following are other minerals observed, inclosed in rock-crystal; epidote, schorl, garnet, chlorite, mica, asbestos, actynolite, fluor-spar, heavy-spar, native silver, specular iron-ore, needles of manganese-ore, and of grey antimony-ore, and crystals and grains of arsenical pyrites, and rutile. Sometimes the crystals of grey antimony-ore, manganese, and rutile, are decomposed and carried away by some agent unknown to us, and then the rock-crystal appears traversed by a number of hollow prismatic canals.

Geographic Situation.

Europe.—Crystals of great size and beauty are found in different parts of Scotland; the rock-crystals of the Island of Arran, which occur in drusy cavities in granite, are well known; but the largest and most valuable are found in the neighbourhood

neighbourhood of Cairngorm, in the upper part of Aberdeenshire, where they occur in granite, or in alluvial soil, along with beryl and topaz. Small but beautiful rock-crystals occur in the secondary greenstone of Burntisland in Fife-shire. It is comparatively rare in England,—a circumstance which ought not to excite surprise, when it is known that the rocks which generally afford this gem occupy but a small part of that portion of the island. It occurs at Dennyval slate quarries, and near Scorrier in Cornwall; near Snowdon in Caernarvonshire; near Bristol; and at Alenheads in Northumberland. On the Continent of Europe it is very widely, and often abundantly distributed. Thus it is found at Kongsberg in Norway, along with native silver; and in the same country, in beds of quartz, in primitive greenstone; likewise in drusy cavities in granite, in the Hartz; in Upper Saxony, in a tinstone formation; Bohemia; in Silesia, in granite; in clay-slate in Bavaria; Tyrol; Carinthia; Carniola; Italy; Hungary; Transylvania; Switzerland, particularly in Mont Blanc; Spain; and France, particularly in Dauphiny, where very magnificent groupes of crystals are found.

Asia.—Island of Ceylon; Catharinenburg; Adon-Tschelon, along with beryl; at Nertschinsk.

Africa.—Large and beautiful crystals, which are sometimes traversed by crystals of rutile, are found in Madagascar*.

America.—Beautiful small crystals are found at Cape Diamond near Quebec; in West Greenland, and many other

* It is mentioned in Fresange's Voyage to Madagascar, that crystals twenty feet in circumference occur in that island. Here we must suppose that massive quartz and rock-crystal have been confounded together.—*An. des Voyages, de la Geographie, et de l'Histoire, par Malte Brun, Paris, t. ii.*

[Subsp. 2. *Rock or Mountain Crystal.*

other parts in North America, particularly the United States.

Large and beautiful crystals are found in the Brazils, in the Caraccas, and other districts of South America.

Uses.

Rock-crystal is cut and polished as an inferior kind of gem or ornamental stone. It receives the required shape by sawing, splitting, and grinding. The sawing is effected by means of an extended copper-wire fixed to a bow; the wire is coated with a mixture of oil and emery, and is drawn backwards and forwards until the operation is finished. As this process is a very tedious one, particularly when the mass is large, a more expeditious, although less certain, method is sometimes followed: The crystal is heated red-hot, and then a wet cord is drawn across in the direction we intend to split it; by the rapid cooling thus effected in the direction of the cord, the stone easily splits, and generally in the desired direction, by a single blow of a hammer. The grinding is done by means of emery; and the polishing with tin ashes and tripoli *. It is most advantageously

* The cutting and polishing of gems differs considerably from that of diamond-cutting, already described. The form intended to be given to the gem being determined on, it is cemented to the end of a stick, and the facets are set on, not by cutting its surface by means of a diamond, but by applying it to the mill. The mill is a plate of copper, or of an alloy of lead and tin, to which a horizontal motion is given by a simple piece of machinery. Its surface being charged with diamond-powder and oil, or with fine emery and water, (the former of these, however, is preferred, the rapidity with which it works being such as to make up for the difference of price between the two materials), a thick peg of wood, called a gauge, pierced with small holes in all directions, is set upright on the lapidary's bench, close to the mill; and

advantageously cut into steps, when used either for seals, or for other purposes; the breadth of the table should be proportioned to the fulness of the colour, and it should be set with an appropriate foil of a pale colour.

Different kinds of work in rock-crystal must be perforated, and the perforation is executed by means of the diamond-splitter and a drill machine. It is cut into ring-stones, seal-stones, necklaces and ear-drops; and when the masses are large, into snuff-boxes, vases, and ornaments for chandeliers.

and the process of setting the facets takes place in the following manner:—The stone is placed on the surface of the mill, the opposite end of the stick to which it is cemented being inserted in one of the holes of the guage. In this position, it is kept steady by the workman with the right hand, while with the other he puts the mill in motion, by turning a winch. The direction of the motion given to the mill, is such as tends to draw the stick out of the guage; for, if given in a contrary direction, it would soon flaw and tear up the folia of the stone. The skill of the lapidary depends on regulating the velocity of the mill, and pressing with more or less force on the stick, with an almost imperceptible tendency to one or other direction, in different stages of the work, examining each facet at very short intervals, in order to give as great precision as possible to its size and form. This being completed, the cutting-mill is taken out, and replaced by one of brass, on which the polishing is performed, by means of fine emery, tripoli, and rotten-stone, exactly in the same manner as practised in the first stage of the process for setting diamonds.

Considerable judgment is required in determining the form and proportions best adapted to show the beauty of any particular stone. If the colour of the stone is deep, and its transparency perfect, the best form to give it is the brilliant; but if the colour is pale and light, the most advantageous mode of cutting it, is to cut the table side in the brilliant form, and the collet side in steps: by this means the table will be left dark, while all the light reflected from the steps on the under side of the stone, will be thrown up into the facets, by which the table is surrounded. When the stone possesses opalescence, play of colour, &c. such as opal and Labrador felspar, they ought to be cut more or less hemispherical or elliptical, without any flat facets, but highly polished. In France, certain dark-coloured gems, as garnet, and semi-transparent ones as chrysoprase, are cut *en cabochon*, with a single row of small facets surrounding the base.—*Mawe's Treatise on Precious Stones.*

chandeliers. The ancients valued vases of this stone very highly, particularly when of considerable size. Such were the two cups which the tyrant Nero broke into pieces in a fit of despair, when he was informed of the revolt which caused his destruction. One of these was estimated at 15,000 livres. At Briançon there was formerly a manufactory, where the rock-crystal of Dauphiny was worked into ornaments for chandeliers.

When perfectly pure, it is much in request by opticians, who cut it into glasses for those spectacles which are called *pebbles*, and who use it for various optical instruments. The best crystal is imported from Brazil and Madagascar, in blocks, not unfrequently from 50 lb. to 100 lb. weight. It is sold at various prices, from five to twenty shillings a pound, according to its quality.

The deep wine-yellow, and clove-brown coloured varieties are those most highly esteemed as articles of jewellery, and are made up into necklaces and ear-drops, or are cut into seal-stones and brooches. It is an excellent stone for engraving upon, and hence, occasionally, beautiful figures and groupes are cut on it. These beautiful varieties are found in different parts of Scotland, but particularly in the granite mountains towards the source of the Dee. Of these mountains the most universally known is Cairngorm, and hence these stones are in trade known under the name *Cairngorum Stones*. The rock-crystal of Brazil and Madagascar, is in general of a deeper and richer colour than that of Scotland, and can be purchased at a cheaper rate; and as there is a natural prejudice in favour of the productions of our own country, these also are sold under the name *Cairngorum Stones*. The deep coloured yellow varieties, when well cut and set, are sold as topazes. The clove-brown varieties are known to jewellers under the name

Smoke Topaz, but these, and all other varieties of rock-crystal, may be readily distinguished from topaz, even when polished, by the following characters : Topaz scratches rock-crystal, but it is not affected by rock-crystal ; topaz has a specific gravity of 3.5, whereas that of rock-crystal is only 2.65 ; and topaz retains the electricity it acquires by friction twenty-four hours and upwards, but rock-crystal seldom half an hour, and often much less ; and, lastly, the topazes of Brazil and Siberia, and also many of those of Saxony, become electrical by heating, which is not the case with rock-crystal.

We sometimes observe on the surface, or in the interior of rock-crystals, a beautiful iridescence. This property, when superficial, is owing to a slight covering of metallic oxide ; but when internal, it is caused by the refraction of light, in numerous fissures. This appearance may be artificially produced by heating rock-crystal nearly red hot, and then plunging it into hot water *. Such varieties are esteemed by collectors.

The varieties of rock-crystal that contain vesicular cavities with air and water, and which are known to French collectors under the name *quartz limpide aërohydre*, are much prized by collectors, and sell at a considerable price.

The varieties inclosing crystals of titanium, the *Venus Hair-stones* of amateurs, and those containing crystals of actynolite, or the *Thetis Hair-stones*, are also in much repute with collectors, and sell at a considerable price, when of good colour and transparency. These, and several other varieties, such as those containing chlorite, or needles of manganese, are cut and polished, and worn as ring-stones or brooches.

Different

* This variety of rock-crystal is conjectured to be the *Iris* of Pliny.

Different colours may be communicated to the white varieties of rock-crystal: Thus, if they are heated, and plunged into a solution of indigo, they acquire a blue colour; if into a decoction of cochineal, a red colour; or if into a solution of copper, a blue tint. A clove-brown colour may be given to white-coloured crystals, by exposing them to the vapour of burning wood. Artists sometimes communicate beautiful colours to rock-crystals, by forming them into *doublets*. Two modes are followed. In the one, we take a semibrilliant of rock-crystal, and hollow it underneath, and fill the hollow with a liquor of the colour we wish the stone to exhibit, and then inclose it by a plate of glass. If this kind of doublet is dexterously made, we do not readily discover that the stone is hollow underneath, and only coloured in the middle, but the whole mass appears of an uniform tint. The second kind of doublet is formed, by cementing a coloured plate of glass on the base of a roset or brilliant cut rock-crystal, by means of which the whole stone acquires the colour of the plate.

Rock-crystal is sometimes imitated by artificial pastes; but these can be distinguished from the true stone by their inferior hardness, and their containing roundish air-vesicles irregularly distributed throughout the mass.

Of these pastes, the most celebrated is that known under the name of *Strass paste*.

Observations.

1. This subspecies of quartz is characterized by its frequent pale colours, its constant regular form, its lustre, cleavage, fracture, and perfect transparency. It is distinguished from *amethyst* by its colours, its prisma-

tic figure, its perfect conchoidal fracture, imperfect cleavage, which seldom occur in amethyst; lastly, its greater transparency, and different geognostic situation. Its stronger lustre and transparency, and conchoidal fracture, distinguish it from *common quartz*. Its low degree of lustre distinguishes it from the *diamond*, which is remarkable for its high adamantine lustre; and pure rock-crystal has a higher degree of transparency than that gem. The same characters enable us to distinguish it from zircon and white sapphire.

2. Transparent snow-white rock-crystal resembles glass in its general appearance; but, independent of other characters, the vesicles and rents that occur in both afford an easy mode of distinguishing them; the air-bubbles or vesicles in glass being irregularly diffused, and nearly of a globular shape; while in rock-crystal they are disposed in the same plane or parallel planes; and generally in the form of clouded specks.

Third Subspecies.

Rose or Milk Quartz *.

Milch Quartz, *Werner*.

Rosen rother Quarz, *Wid.* s. 301.—Rosy red Quartz, *Kirw.* vol. i. p. 245.—Milch Quarz, *Emm.* b. i. s. 136.—Quartz laiteux, *Lam.* t. ii. p. 123.—Quartz laiteux, ou Quartz Rose, *Broch.* t. i. p. 246.—Quartz-hyalin-rose, *Haüy*, t. ii. p. 418.—Milch Quarz, *Reuss*, b. ii. th. i. s. 221. *Id. Lud.* b. i. s. 76. *Id. Suck.* 1^r th. s. 283. *Id. Bert.* s. 255. *Id. Mohs*, b. i. s. 220. *Id. Hab.* s. 4.

Quartz

* *Rose Quartz*, from its rose-red colour; *Milk Quartz*, from the opaline milky appearance it often exhibits, particularly when cut.

—Quartz rose, *Lucas*, p. 32.—Quartz-hyalin, *Brong.* t. i. p. 278.
—Quartz rose, *Brard*, p. 93.—Transparent rose-red Quartz, *Kid*, vol. i. p. 199.—Quartz rose, *Hauy*, Tabl. p. 25.—Milch Quarz, *Steffens*, b. i. s. 112.—Rosen Quarz, & Milch Quarz, *Haus. Handb.* b. ix. s. 382.—Milch Quarz, *Hoff.* b. ii. s. 31.
Milk Quartz, *Aikin*, p. 177.

External Characters.

Its most common colours are rose-red and milk-white. The rose-red colour sometimes inclines to flesh-red, and passes into crimson-red, reddish-white, pearl-grey, and, lastly, into milk-white, which reflects a yellowish light, and often passes into blue.

It occurs only massive.

Some varieties shew a tendency to straight and thick lamellar distinct concretions.

Internally its lustre is shining, sometimes passing to splendid, and is vitreous, slightly inclining to resinous.

The fracture is more or less perfect and flat conchoidal.

The fragments are indeterminate angular and sharp-edged.

It is more or less translucent, even approaching to semi-transparent.

The other characters are the same as those of rock-crystal.

Constituent Parts.

It is supposed to be silica coloured with manganese.

Geognostic Situation.

It occurs in masses, included in beds of quartz subordinate to granite and gneiss, and in veins of manganese in granite.

Geographic

Geographic Situation.

Europe.—It was first discovered in Bavaria, where it occurs in beds of quartz in ^{*}granite near Zwiesel; also in the Hörlberg in the Forest of Bohemia, and in the Harlachberg, near Bodenmais. Pale rose-red, and ~~milk~~ white varieties occur near Hohenstein in Saxony; rose-red at Arendal in Norway; milk-white in Spain; rose-red at Chateau-neuf in Auvergne and Moisin in France; and pale rose-red and milk-white in the Island of Coll, one of the Hebrides.

Asia.—Very beautiful rose-red semitransparent varieties occur in the Kolywan mountains, and in the Tigerezkischen snow mountains.

America.—At Topsham in Mainè, in the United States, and in South Greenland.

Uses.

It is employed in jewellery, and the larger masses are cut into vases ^{*}. It takes a fine polish, and when the colour is good, the ornaments made of it are beautiful. When cut and polished, and of a good colour, it is sold for spinel; yet its deficiency in hardness, transparency, and fire, is so great, that the deception is easily detected †.

Observations.

1. This subspecies is distinguished from Rock-crystal, the only one of the subspecies of the quartz species with which

M. Dedrée has in his possession a beautiful vase of rose quartz.

In the district of Kolyvan in Siberia, it is cut into elegant vases.

• which it could be confounded, by its colour, massive external shape, fracture, lustre, and lamellar concretions.

2. The milk or bluish-white variety of this mineral, is by some jewellers named *false sapphire*, or *occidental sapphire*.

3. It loses its colour by keeping, particularly in a warm place.

Fourth Subspecies.

Common Quartz.

Gemeiner Quartz, Werner.

Quartzum rude, *Wall.* t. i. p. 220. *Id.* *Romé de Lisle*.—Gemeiner Quartz, *Wid.* p. 300.—Quartz, *Kirn.* vol. i. p. 242. *Id.* *Estner*, b. ii. s. 265. *Id.* *Emm.* b. i. s. 125.—Quarzo, *Nap.* p. 170. *Id.* *Lam.* t. ii. p. 119.—Quartz hyalin amorphe, *Haüy*, t. ii. p. 423.—Le Quartz commune, *Broch.* t. i. p. 248.—Gemeiner Quarz, *Reuss*, b. ii. s. 44. *Id.* *Lud.* b. i. s. 76. *Id.* *Mohs*, b. i. s. 222–245. *Id.* *Bert.* s. 250. *Id.* *Suck.* 1st th. s. 290. *Id.* *Hab.* s. 5.—Quartz hyalin opaque, *Iacus*, p. 32.—Quartz hyalin amorphe, *Bong.* t. i. p. 274.—Quartz hyaline opaque, *Brard*, p. 94.—Quartz amorphe, *Haüy*, *Tabl.* p. 25.—Gemeiner Quarz, *Steffens*, b. i. s. 119. *Id.* *Hoff.* b. ii. s. 34.

External Characters.

The colours of common quartz are very various. The most common are white and grey; less frequent are yellow, brown and red, and the rarest are green, blue and black. Of white, the following varieties have been observed: snow-white, greyish-white, yellowish-white, greenish-white, and reddish-white: from greenish-white it passes into a colour intermediate between verdigris-green and mountain-green, and

and into pale olive green. The varieties of grey are ash-grey, smoke-grey, yellowish-grey, pearl-grey, and bluish-grey. From bluish-grey it passes into dark indigo-blue, Berlin-blue, and violet-blue. From yellowish-grey it passes into wax and honey yellow; from pearl-grey into flesh-red, blood-red, brick-red, and further into hyacinth-red, reddish-brown, and pale chesnut-brown. From dark ash-grey into greyish-black.

The varieties of external shape are even more numerous than those of colour.

It occurs most commonly massive, disseminated, in blunted pieces, in grains of different sizes and forms: also in plates, stalactitic, reniform, botryoidal, globular, specular, corroded, vesicular, ramosc, amorphous, cellular, and with impressions; of the cellular it presents the following varieties, hexagonal, polygonal, and circulo-cellular; and of this latter form, the parallel, double and spongiform varieties.

The impressed forms are tabular, cubical, pyramidal, and conical.

It sometimes occurs in distinct concretions. These are granular, prismatic, and rarely lamellar. The granular concretions vary from very large to small, and are round, angulo-granular, and date-shaped granular, and often one or two varieties occur included in the other. The granular variety is sometimes flexible. The prismatic concretions are parallel and scopiform diverging, varying from thick to very thin. The lamellar concretions are thick and straight.

It occurs in true and supposititious crystals.

The following are the true crystals, which conjoin those of rock-crystal and amethyst.

1. Six-sided prism acuminate on both extremities by

six planes. It is either crystallized on both extremities, and then it is imbedded, or crystallized only at one extremity, and then it adheres.

2. Simple six-sided pyramid. The crystals of this figure are either single, resting on each other, or are aggregated in form of a bud.
3. Double six-sided pyramid, which is sometimes aggregated in rows.

The surface of the crystals is the same as in rock-crystal.

The following are the supposititious crystals :

1. Double six-sided pyramid, hollow, and the surface drusy. Originates from calcareous-spar.
2. Single and double three-sided pyramid, hollow, and surface drusy. Originates from calcareous-spar.
3. Regular octahedron, sometimes hollow, and surface drusy. Originates from fluor-spar.
4. Cube. Originates from fluor-spar.
5. Rectangular four-sided table, hollow, and surface drusy. Originates from heavy-spar.
6. Oblique four-sided table, surface drusy. Originates from heavy-spar.
7. Eight-sided table, sometimes hollow, sometimes partly filled with straight lamellar heavy-spar, and the surface drusy. Originates from heavy-spar.
8. Lens, hollow, and surface drusy. Originates from gypsum.

The crystals occur of every size, from very small to very large, but they never attain the magnitude of rock-crystal. The prisms are generally larger than the pyramids.

Externally

Externally the lustre of the true crystals varies from splendid to glistening; that of the rolled pieces is glimmering, passing into dull.

Internally it is shining, which sometimes borders on glistening, and sometimes approaches to glimmering, and is vitreous.

Its cleavage, which is very rarely discoverable, is imperfect.

The fracture is coarse splintery, and sometimes small-grained uneven, which latter passes into small and imperfect conchoidal. It sometimes occurs slaty.

The fragments are indeterminate angular, and sharp-edged.

It is generally translucent, seldom semitransparent*, and the darker varieties are only translucent on the edges.

The other characters the same as those of rock-crystal.

Chemical Characters.

It is infusible without addition before the blowpipe, but when exposed to a stream of oxygen gas, it melts into a milk-white porcellanous bead.

Geognostic Situation.

This is one of the most abundant minerals in nature, and appears in many different geognostic situations. It occurs in primitive, secondary, alluvial and volcanic rocks, and either as a constituent part of these rocks, or associated with them in the form of beds and veins. Thus it forms a principal constituent part of granite, one of the most frequent and abundant of rocks; it is also one of the component

* It is only in the crystallized varieties that semitransparency occurs.

component parts of gneiss, mica-slate, and topaz-rock : occurs imbedded in grains and crystals in porphyry, and accidentally intermixed with clay-slate and limestone. Beds of quartz occur in granite, gneiss, mica-slate, and clay-slate : and these beds are sometimes several hundred fathoms thick, and form whole hills, or ranges of hills.

Most of the veins that traverse primitive rocks, with the exception of those that afford fluor-spar, heavy-spar, and some other minerals, contain common quartz. These veins are frequently entirely composed of quartz, and are of great width and extent ; indeed they are so large, that Dolomieu and others maintain, although erroneously, that quartz occurs more abundantly in veins than in any other kind of repository.

It also occurs in metalliferous beds along with ores of different kinds, as galena or lead-glance, tinstone, and various pyritical minerals.

It occurs in vast abundance in secondary mountains, in the form of sandstone, and also in beds subordinate to gypsum and limestone. The numerous veins that traverse the different rocks of the secondary or flint class are very often particularly distinguished by the common quartz which they contain.

The alluvial deposits so abundantly and widely spread over the face of the earth, contain enormous accumulations of quartz, in the form of rolled pieces, gravel, and sand.

Its distribution in true volcanic rocks is not well understood.

Geographic Situation.

Europe.—This mineral, in the form of quartz-rock, occurs very abundantly in the Highland Districts of Scotland, where

where it is disposed in beds or veins in primitive and secondary rocks. Its various geognostic relations may be studied with great advantage in many of the Hebrides, particularly in Isla and Jura, and on the mainland on the coasts of Caithness, Sutherland, Ross-shire, Inverness-shire, and Argyleshire. Whole hills, and ranges of hills, of quartz-rock occur in the interior of Scotland, and it abounds in many of the Hebrides and Shetland islands. In the form of sandstone, it skirts the east coast of Scotland, almost uninterruptedly from Berwick to Stonehaven, and, after an interruption of primitive rocks, continues to bound the shores from Buckie to the Pentland Frith. The sandstone also forms extensive tracts on the west coast, and many considerable tracts of this rock extend from the coast into the interior parts of the country. Some groupes of islands, such as the Orkneys, are almost entirely composed of quartz, in the form of sandstone.

It occurs in the Primitive Mountains of England; but not so abundantly as in Scotland. It also forms a principal constituent part of the different sandstones of the lower and flatter parts of England, and appears in veins that traverse not only sandstone but also limestone, trap, and other rocks.

It is abundant in the primitive and secondary mountains of Ireland.

In the alluvial districts in the different parts of Britain and Ireland, it abounds in the form of gravel and sand.

On the Continent of Europe it is very abundantly and widely distributed; indeed we cannot name a country, from the coast of Norway to the Black Sea, and from the Arctic Ocean to the Mediterranean Sea, that does not contain much common quartz

Asia.

Asia.—A beautiful indigo-blue variety, along with the common varieties, occurs in the Island of Ceylon. In Siberia it occurs in vast abundance, either as a constituent part of mountain rocks, or in beds alternating with them, or in veins traversing them. In the peninsula of India, it appears as a constituent part of granite, gneiss, and mica-slate, in the form of quartz-rock, also accidentally mixed with clay-slate, and as a constituent part of various sandstones.

Africa.—At the Cape of Good Hope it occurs in veins, and as a constituent part of granite; and the great ranges of mountains to the north of that promontory are formed of sandstone, of which this mineral forms a principal ingredient. The vast sandy deserts that occupy so great a portion of the surface of Africa, contain much common quartz.

America.—The great tracts of primitive and secondary rock in the northern and southern parts of North America abound in common quartz. The limestone districts afford smaller portions of it, but in some places on the coasts of the ocean it abounds in the form of sand.

In South America it is an abundant mineral, appearing in its usual geognostic situations, in the primitive, secondary, and alluvial strata which form that vast continent. The flexible variety was first found in Brazil, and has been lately observed in North America *.

Uses.

It is employed in the manufacture of glass and artificial gems; also in the preparation of smalt, and as an ingredient in porcelain and different kinds of pottery. The vesicular

* Greenough.

sicular and corroded variety forms a most excellent mill-stone, known in commerce under the name of *Buhr-stone*. This buhr-stone has hitherto been found only in France; but it is so much esteemed in this country, that the Society of Arts of London have for many years past offered annually a considerable reward for its discovery in Great Britain.

Some porous varieties are used as filtering-stones, or quartz-sand is so arranged as to form a filtering-apparatus. When it is pure, and the grains are of equal size, it is used for polishing glass.

In the form of sand, it is used with quicklime, in the composition of mortar, and in agriculture, for the improvement of particular kinds of soil. Sometimes the massive varieties are employed as paving stones, and in the coarser kinds of masonry.

Some varieties of common quartz exhibit numerous points or spots that glitter like gold. This appearance is sometimes owing to the intermixture of scales of mica; in other instances it is caused by reflection from numerous small rents or fissures in the stone. These varieties have received the name *Aventurine*, from the following circumstance: A French workman having by accident, (*par aventure*) dropped filings of brass or copper into a vitreous mixture in a state of fusion, gave the name *Aventurine* to the glittering mixture thus formed, and of which artists make vases and other ornamental articles. Mineralogists have applied the same name to those varieties of common quartz that exhibit a nearly similar appearance. These are cut into various ornamental articles, and are sometimes sold at a very high price. The natural aventurine is found in Arragon in Spain; at Face-bay in Transylvania; and in the vicinity of Quimper in Brittany.

Mr Greenough found it near Fort-William, in the Highlands of Scotland ; and I observed it in Mainland, one of the Shetland islands.

Observations.

1. It is distinguished from *rock-crystal* by its colour-suite ; its various particular and supposititious forms ; the greater regularity of its crystallizations ; its lower degree of lustre and transparency ; splintery or imperfect conchoidal fracture ; and distinct concretions.

2. The *indicolite* and *siderite*, which occur in veins in gypsum, in the country of Salzburg, and which have been considered either as new species or varieties of quartz, are iolite. The blue quartz of Finland, named by some *Steinheilite*, which I have never seen, has been referred both to the quartz and iolite species.

3. There occurs near Nantz in France, a variety of common quartz, (imbedded in granite), of a grey colour, conchoidal, passing to splintery fracture, and semitransparent, which, when broken, exhales a disagreeable smell, somewhat resembling that of sulphureted or carbonated hydrogen. It is by Steffens arranged as a distinct subspecies of common quartz, under the title *Stink-quartz*.

4. The *flexible sandstone*, or granular quartz of Brazil, is described by some mineralogists, as Steffens, under the name *gelenk-quartz*. It is not a pure quartz, being also intermixed with scales of mica, which give its flexible character, and also with grains of schorl. A micaceous granular quartz of the same description has been found by Esmark in Tellemark in Norway.

5. The red crystallized variety of common quartz, found in gypsum near Compostella in Spain, used to be described under the title of *Compostella Hyacinth*.

Fifth Subspecies.

Prase *.

Prasem, Werner.

Quartzum coloratum viride? *Wall.* t. i. p. 214.—*Prasem*, *Wern.* *Cronst.* s. 116.—*Lauchgruner Quartz*, *Wid.* p. 301.—*Prasium*, *Kirw.* vol. i. p. 249. *Id. Estner*, b. ii. s. 207. *Id. Emm.* b. i. s. 103.—*Quarzo verde di porro*, *Nap.* p. 171.—*La Prase*, * *Broch.* t. ii. p. 252.—*Quartz hyalin verd obscur*, *Haüy*, t. iii. p. 419.—*Prasem*, *Reuss*, b. ii. s. 235. *Id. Lud.* b. i. s. 76-77. *Id. Suck.* 1r th. s. 299-300. *Id. Bert.* s. 171. *Id. Mohs*, b. i. s. 163. *Id. Hab.* s. 5.—*Quartz hyalin vert obscur*, *Lucas*, p. 32.—*Quartz Prase*, *Brong.* t. i. p. 280.—*Quartz hyalin vert obscur*, *Brard*, p. 93.—*Prase*, *Kid*, vol. i. p. 203. *Id. Haüy*, *Tabl.* p. 25.—*Prase*, *Steffens*, b. i. s. 113.—*Prasem*, *Hoff.* b. ii. s. 56. *Id. Haus.* b. ii. s. 383. *Id. Aikin*, p. 177.

External Characters.

Its colour is leek-green, of various degrees of intensity, very rarely inclining to olive-green.

It occurs generally massive: the massive varieties occur in distinct concretions, which are cuneiform, prismatic, and sometimes coarse granular.

It seldom occurs crystallized; and its crystallizations are the following:

1. Six-sided prism, acuminate by six planes, like quartz.
2. Six-sided pyramid, truncated on the common basis, and either single or double.

The

* The name *Prase* is from the Greek word *πράσιος*, leek-green, which is the principal colour of this mineral.

[Subsp. 5. Prase.

The crystals are small, and middle sized, and the surface is generally rough or drusy.

The surface of the concretions is rough and transversely streaked.

Its lustre is shining, approaching to glistening, and is resino-vitreous.

The fracture is imperfect, and flat conchoidal, passing into coarse splintery.

The fragments are indeterminate angular, and more or less sharp-edged.

It is translucent.

It is hard.

It is rather difficultly frangible.

Specific gravity 2.677, *Karsten*.—2.66,—2.685, *Breithaupt*.

Constituent Parts.

Silica,	-	98.5
Alumina with Magnesia,		0.5
Oxide of Iron,	-	1.0
		<hr/>
		100

Bucholz in Journ. für die Chem. & Phys.
vi. H. 1. s. 151.

Geognostic Situation.

It occurs in mineral beds, which are composed of magnetic ironstone, magnetic pyrites, iron-pyrites, copper-pyrites, galena or lead glance, blende, quartz, calcareous-spar and common actynolite. These beds are probably connected with primitive trap.

It exhibits a beautiful opalescence, particularly when cut in a convex form ⁴.

It is found in blunt-edged pieces, in rolled pieces, and also massive.

Internally it is shining, and the lustre is vitreo-resinous.

The fracture is small, and rather imperfect conchoidal, sometimes approaching to uneven.

The fragments are indeterminate angular, and more or less sharp-edged.

It is generally translucent, sometimes also semitransparent, and translucent on the edges.

It is hard.

It is easily frangible.

Specific gravity from 2.625 to 2.600, *Klaproth*.—2.647, *Lowry*.

Chemical Characters.

In the heat of a porcelain furnace it loses its hardness, lustre, and transparency, and partly its colour, but is not melted. Before the blowpipe, according to Saussure, it melts with great difficulty.

Constituent Parts.

Silica,	95.00	94.50
Alumina,	1.75	2.00
Lime,	1.50	1.50
Oxide of Iron,	0.25	0.25
Loss,	1.50	1.75
	<hr/>	<hr/>
	100	100

Klaproth, *Beit. t. i. p. 90.*

Geognostic

⁴ It is usually brought into Europe cut in a convex form.

Geognostic Situation.

In the Hartz it is said to occur in coteremporaneous veins along with quartz, amianthus, asbestos, axinite, and calcareous-spar, in primitive trap; and in gneiss in the Island of Ceylon.

Geographic Situation.

Europe.—In the vicinity of Treseburg in the Hartz in Hanover, and near Hoff in Bareuth.

Asia.—Island of Ceylon, and coast of Malabar.

Africa.—It is said to occur in Egypt.

America.—In North Greenland*.

Uses.

It is generally cut into ring-stones; and the most advantageous form for displaying its peculiar lustre is the oval, with a convex surface. The red and olive-green varieties are the most highly prized.

Observations.

1. It has been by some mineralogists referred to Opal, by others to Felspar: it is, however, sufficiently distinguished from opal by its hardness and weight; and its fracture distinguishes it from felspar.

2. The beautiful opalescence of this gem appears to be owing to minute fibres, distributed through it, which have a brighter colour, but lower transparency, than the mineral itself, and from which the light producing the opalescence is reflected.

Scventh

* Glesecké.

*Seventh Subspecies.***Fibrous Quartz.****Faser Kiesel, Werner.****Faser Kiesel, Hoff. b. ii. s. 189.***External Characters.*

Its colours are greenish and yellowish-white. It is often stained yellowish-brown in the rents with iron-ochre.

It occurs massive, and in rolled pieces.

It occurs in curved fibrous concretions, which sometimes cross each other promiscuously.

Internally it is glistening or glimmering, and is pearly.

The fracture is curved slaty.

The fragments are indeterminate angular, wedge-shaped, and splintery.

It is highly translucent on the edges, passing into translucent. When cut in a convex form, it shews a feeble opalescence, like that of the cat's-eye.

It is nearly as hard as quartz.

It is not very difficultly frangible.

Specific gravity 3.123, 3.192? *Breithaupt.*

Geognostic and Geographic Situations.

It occurs on the banks of the Moldare in Bohemia.

Observations.

1. Colour, fracture, fragments, degree of transparency, opalescence, and weight, distinguish it as a subspecies of quartz.

2. It

2. It is distinguished from *Cat's-eye* by its lighter colours, delicate prismatic concretions, inferior hardness, inferior opalescence, and greater weight.

3. Werner is of opinion, that it is an intimate mixture of quartz and asbestous actynolite.

Eighth Subspecies.

Iron-Flint.

Eisenkiesel, *Werner*.

Le Cailloux ferrugineux, *Broch.* t. i. p. 238.—Quartz rubigineux, *Haiiy*, *Tabl.* p. 25.—Eisenkiesel, *Reuss*, b. ii. th. i. s. 300. *Id. Lud.* b. i. s. 73. *Id. Suck.* 1r th. s. 347. *Id. Bert.* s. 270. *Id. Mohs*, b. i. s. 187.—Quartz rubigineux, *Brong.* t. i. p. 281.—Eisenkiesel, *Haus.* s. 6. *Id. Steffens*, b. i. s. 126. *Id. Hoff.* b. ii. s. 60. *Id. Oken*, b. i. s. 270. *Id. Haus. Handb.* b. ii. s. 395.

External Characters.

The principal colours are brown and red. The brown colours are yellowish-brown, which sometimes approaches to ochre-yellow; farther, a colour intermediate between chestnut and liver brown, and brownish-black. The only red colour is one intermediate between brownish-red and blood-red.

It occurs most commonly massive, but also crystallized in small equiangular six-sided prisms, which are acuminate on both extremities by three or six planes, which are set on the lateral planes.

It occurs almost always in small angulo-granular distinct concretions, which approach sometimes to the fine, and more rarely to the coarse granular.

Externally

Externally its lustre is shining, approaching to glistening; internally it is glistening, and is vitreo-resinous.

The fracture is imperfect, and small conchoidal, which, in some varieties, approaches to uneven.

The fragments are angular, and rather sharp-edged.

It is opaque.

It gives sparks with steel.

It is rather difficultly frangible.

Specific gravity, 2.627, 2.691, 2.814, 2.838, *Haberle*.
2.576, 2.618, 2.746, *Hoffmann*.

Chemical Character.

Is infusible without addition before the blowpipe.

Constituent Parts.

Yellow Iron-Flint.		Yellowish-brown Iron-Flint.	
Silica,	93.5	Silica,	92.00
Oxide of Iron,	5.0	Oxide of Iron,	5.75
Volatile matter,	1.0	Oxide of Manganese,	0.00
	—	Volatile matter,	1.00
<i>Bucholz,</i>	99.5	<i>Bucholz,</i>	99.75
Red Iron-Flint.			
Silica,	-	-	76 $\frac{5}{8}$
Alumina,	-	-	$\frac{1}{4}$
Red Oxide of Iron,	-	-	21 $\frac{1}{8}$
Volatile matter,	-	-	1
			—
<i>Bucholz,</i>		<i>Bucholz,</i>	99 $\frac{1}{4}$

Geognostic Situation.

It occurs in veins of ironstone; the red variety in red ironstone, the brown, in brown ironstone; and also in trap rocks.

Geographic

Geographic Situation.

Europe.—In rocks near Bristol; in trap rocks that lie over white limestone, island of Rathlin, off the coast of Ireland *; and in trap rocks at Dunbar in Scotland. At Orpes, Hohenstein, and Sedlitz in Bohemia; in the Fichtelgebirge in Franconia; in brown ironstone veins at Ilfeldt and Fischbach in the Hartz; in ironstone veins at Altenberg, Eibenstock in Upper Saxony, and at Oberstein on the Rhine.

Asia.—According to M. Von Moll, it occurs in Siberia.

Observations.

1. It appears to be a chemical compound of quartz and iron-ochre.

2. It renders the iron-ore along with which it occurs, very difficult of fusion.

3. It is intermediate between common quartz and jasper. It is distinguished from *common quartz* by colour, lustre, distinct concretions, opacity, and rather greater weight; from *jasper*, by its tendency to a regular form, its distinct concretions, resinous lustre, greater hardness and weight.

Ninth

* Greenough.

Ninth Subspecies.

Hornstone *.

Hornstein, *Werner*.

This subspecies is divided into three kinds, viz. Splintery Hornstone, Conchoidal Hornstone, and Woodstone.

First Kind.

Splintery Hornstone.

Splittriger Hornstein, *Werner*.

Splittriger Hornstein, *Wern.* Pabst. t. i. p. 247.—Petrosilex squamosus, *Wall.* t. i. p. 280.—Splittriger Hornstein, *Emm.* b. i. s. 251. *Id. Estner.*—Le Hornstein cailleux, *Broch.* t. i. p. 255.—Splittriger Hornstein, *Reuss*, b. ii. th. i. s. 325. *Id. Lud.* b. i. s. 77. *Id. Suck.* 1^r th. s. 356,–360. *Id. Bert.* s. 234. *Id. Mohs*, b. i. s. 248. *Id. Hab.* s. 14.—Silex corné, *Brong.* t. i. p. 319.—Quartz agathe grossier, *Haüy*, Tabl. p. 27.—Splittriger Hornstein, *Steffens*, b. i. s. 167. *Id. Hoff.* b. ii. s. 65. *Id. Lenz*, b. i. s. 366. *Id. Oken*, b. i. s. 299. *Id. Haus.* b. ii. s. 402.

External Characters.

Its principal colours are grey, red, and green, of which the following varieties occur: Of grey; bluish, greenish, yellowish, smoke and pearl grey: From pearl-grey it passes into flesh-red, brick-red, brownish-red, and reddish-brown: it seldom inclines to ochre-yellow: from greenish-grey it passes into mountain and pale olive green; and from pale smoke-grey into greyish-white, and yellowish-white.

It

* The name *Hornstone* given to this mineral, originated with the splintery kind, which resembles horn in colour, fracture, and translucency.

It occurs generally massive, sometimes also in large balls, and seldom with pyramidal impressions from calcareous spar.

occurs in lenticular, and six-sided prismatic supposititious crystals.

The globular varieties occur in thick concentric lamellar distinct concretions.

Internally it is always dull.

The fracture is splintery, generally small, and fine, seldom coarse splintery; the latter sometimes approaches to large conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

It is more or less translucent on the edges, but some varieties that incline to quartz, and which are coarse splintery, are translucent.

It is hard, but not in so high a degree as quartz or flint.

It is difficultly frangible.

Specific gravity, 2.536, 2.602, 2.626, 2.635, *Hoffmann*.

Chemical Characters.

Infusible without addition before the blowpipe.

The fusible varieties mentioned by some mineralogists, are compact felspar.

Constituent Parts.

Pearl-grey from Schneeberg.

Silica,	-	98.25
Alumina,	- -	0.75
Oxide of Iron,	-	0.50
Water,	- -	0.50

100

Klaproth, *Beit. b. vi. s. 232.*

Geognostic

Geognostic Situation.

It occurs in veins in primitive country, along with ores of silver, lead, zinc, copper, and iron; also in the shape of balls in pitchstone and limestone, and forming the basis of hornstone porphyry.

Geographic Situation.

Europe.—In Scotland it occurs sometimes in veins, but most frequently in the form of porphyry, as in the island of Arran, in Perthshire, Argyleshire, Ross-shire, Inverness-shire, Sutherlandshire, Fifeshire, Mid-Lothian, and the Shetland islands. It is a frequent mineral on the Continent of Europe, occurring more or less abundantly in the various countries that extend from Scandinavia to the shores of the Black Sea. In Sweden it occurs in veins, also forming the basis of porphyry, as at Danne-mora and Garpenberg; at Drammen and other parts in Norway; in the Hartz; Lusatia; in the Saxon metalliferous mountains (*Erzgebirge*), where it occurs in veins associated sometimes with ores of silver, galena, and zinc, and sometimes with grey copper-ore, and frequently in veins of red ironstone; in the same country it occurs in balls in pitchstone, and forming the basis of hornstone porphyry.

Asia.—In the silver-mine of Zimcof in the Altain range, in many places in the Uralian Mountains, and in Nepaul.

America.—Mexico, and the United States.

Uses.

Hornstone, in the state of porphyry, forms in some countries an object of considerable importance in an economical point of view. Thus, at Elfdal in Sweden, it is quarried in considerable quantities, and is cut into vases, plates, candlesticks, and a variety of other articles.

2. Hornstone,—1st Kind, Splintery Hornstone.

ticles. It is sometimes raised in large blocks, which, when tastefully cut and polished, have an uncommonly beautiful appearance. The pedestal of the statue of Gustavus III. in Stockholm, and many other beautiful ornaments with which that capital is adorned, are constructed of this hornstone porphyry*.

Observations.

1. *Distinctive Characters.*—*a.* Between splintery hornstone and compact felspar. Compact felspar has a foliated fracture conjoined with the splintery, whereas splintery hornstone is simply splintery: compact felspar has a glimmering, inclining to glistening, lustre, whereas splintery hornstone is dull: compact felspar is not so hard as splintery hornstone: and, lastly, compact felspar melts without addition before the blowpipe, whereas splintery hornstone is infusible.—*b.* Between splintery hornstone and conchoidal hornstone. In splintery hornstone, the colours are duller than in conchoidal hornstone, and are always simple; internally, splintery hornstone is dull, whereas conchoidal hornstone is glimmering or glistening: the fracture of splintery hornstone is splintery, but that of conchoidal hornstone, conchoidal; and splintery hornstone is softer, and more difficultly frangible, than conchoidal hornstone.

2. It passes into compact felspar and claystone; also into quartz, and common jasper; and into calcedony, flint, and flinty-slate.

3. It appears to contain more silica than compact felspar, but less than quartz; hence it is harder than compact felspar, but softer than quartz.

4. Some

* Thomson's Travels in Sweden.—Gottingische's Taschenbuch, v. h. 1913, 135.

4. Some of the varieties of the *petrosilex* of Dolomieu, Lelievre, Brongniart, and Haiiy, appear to be splintery hornstone; others seem to be compact felspar.

5. The Paliopetre and Neopetre of Saussure, appear to include both the splintery hornstone and common flinty-slate of Werner.

6. The Halleflinta of the Swedes (*Petrosilex semipellucidus*, Wall. Syst. Min. t. i. p. 27.), *Petrosilex* of the French, which occurs at Sala, Hällefors, Dannemora in Sweden, and which has been arranged along with hornstone, is generally compact felspar, or an intimate mixture of felspar and quartz.

Second Kind.

Conchoidal Hornstone.

Muschlicher Hornstein, *Werner*.

Muschlicher Hornstein, *Wern. Pabst.* b. i. s. 250.—*Petrosilex æquabilis*, Wall. t. i. p. 281.—Le Hornstein conchoïde, *Broch.* t. i. p. 250.—Muschlicher Hornstein, *Reuss*, b. ii. s. 328. *Id. Lud.* b. i. s. 78. *Id. Suck.* 1r th. s. 360. *Id. Bert.* s. 236. *Id. Mohs*, b. i. s. 255. *Id. Hab.* s. 14. *Id. Steffens*, b. i. s. 169. *Id. Hoff.* b. ii. s. 69. *Id. Lenz*, b. i. s. 368. *Id. Oken*, b. i. s. 360. *Id. Haus.* Handb. b. ii. s. 403.

External Characters.

Its principal colours are grey, white, and red, of which, it exhibits the following varieties, yellowish-grey, greenish-grey, and pearl-grey; from yellowish-grey, it passes into isabella-yellow, yellowish-white, and greyish-white; from
pearl-

[Subg. 9: *Hornstone*.—2d Kind, *Conchoidal Hornstone*.

pearl-grey into **flesh-red** and **cherry-red**; and from greenish-grey into **mountain-green**. The colours are almost always light, and sometimes they occur in spotted, clouded, and striped delineations.

It occurs most frequently massive, sometimes **stalactitic**, often in globular forms, rarely with six-sided pyramidal impressions; and very seldom in the following supposititious crystals:

1. **Flat double three-sided pyramid.**
2. **Acute double six-sided pyramid.**
3. **Six-sided prism, acuminated with three planes.**
4. **Perfect six-sided prism.**

These figures originate from calcareous spar.

Internally it is glimmering, sometimes approaching to glistening, and the lustre is vitreous.

The fracture is more or less perfect and flat conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

It is translucent, but in a lower degree than splintery hornstone.

It is hard; it is harder than splintery hornstone, but not so hard as quartz. .

It is rather difficultly frangible.

Specific gravity, 2.572, 2.580, 2.601, *Hoffmann*.

Geognostic Situation.

It occurs in metalliferous veins and **agate veins**; also, in imbedded portions, in pitchstone porphyry, and in striped jasper. The metalliferous veins contain, besides the hornstone, sometimes ores of silver, of lead, or of cobalt, but never of red ironstone, the ore which frequently accompanies splintery hornstone. In agate veins it is associated with calcedony, &c. *Haberle* says, that it sometimes forms
the

the basis of a porphyry which constitutes whole mountains *; and further, that it passes into pitchstone, and occurs in beds and kidneys in claystone.

Geographic Situation.

It is found along with claystone in the Pentland Hills near Edinburgh; also in Saxony and Bohemia.

Observations.

It is nearly allied to striped jasper.

Third Kind.

Woodstone.

Holzstein, *Werner*.

Holzstein, *Wid.* p. 329.—Woodstone, *Kirm.* vol. i. p. 315.—Le bois pétrifié, ou le Holzstein, *Broch.* t. i. p. 259.—Holzstein, *Reuss*, b. ii. th. i. s. 322. *Id. Lud.* b. i. s. 78. *Id. Bert.* s. 236. *Id. Mohs*, b. i. s. 256. *Id. Hab.* s. 14.—Quartz-agathe xyloide, *Haüy*, *Tabl.* p. 28.—Holzstein, *Steffens*, b. i. s. 171.—*Id. Hoff.* b. ii. s. 72. *Id. Lenz*, b. i. s. 370. *Id. Oken*, b. i. s. 300.

External Characters.

Its most common colour is ash-grey, from which it passes into a greyish-black, and into greyish-white; further into yellowish-grey, sometimes into smoke-grey and pearl-grey, flesh-red, blood-red, and brownish-red. The yellowish-grey passes into wood-brown and hair-brown, and ochre-yellow. It occurs rarely greenish-grey, and mountain-green.

In

* Hoffmann says that it never forms whole beds or mountain-masses.

In general, several colours occur together, and these are arranged in irregular clouded and striped delineations.

It occurs in rolled pieces, and in the shape of trunks, branches, and roots.

Its external surface is uneven and rough.

Internally it is sometimes dull, sometimes glimmering and glistening, according as it is more or less of the nature of the two preceding subspecies.

The cross fracture is imperfect conchoidal; the longitudinal fracture is splintery and fibrous.

The fragments are angular, and rather sharp-edged; sometimes splintery.

It is generally translucent on the edges; sometimes feebly translucent.

It is hard in a low degree.

It is rather difficultly frangible.

Rather heavy.

Specific gravity 2.561, 2.624, 2.636, *Hoffmann*.

Geognostic Situation.

It is found imbedded in sandy loam in alluvial soil; and it is said also in a kind of sandstone-conglomerate and claystone.

Geographic Situation.

Europe.—It occurs at Loch Neagh in Ireland: at Chemnitz and Hilbersdorf in Upper Saxony. In the year 1752, the whole under part of the trunk of a tree with branches and roots, in the state of woodstone, was found near Chemnitz. In the Electoral Cabinet at Dresden there is a specimen of woodstone from Chemnitz: it is a portion of the trunk of a tree, and measures five feet in

length, and as many in diameter. It occurs in Bohemia; Franconia; Silesia; Swabia; Bavaria; Austria; Hungary; Transylvania; and France.

Asia.—Kamtschatka; where whole trees and branches are found in the state of woodstone: also, near Irkuzk, and Catharinenburg.

Use.

It receives a good polish, and hence is sometimes cut as an ornamental stone.

Observations.

1. As woodstone exhibits characters different from all other minerals, it is very properly arranged in the system as a distinct substance.

2. We must be careful not to confound together all the varieties of petrified wood that occur in nature; for wood is sometimes petrified with hornstone, forming Woodstone; sometimes with opal, forming Wood-opal; at other times with common quartz or calcareous earth.

Tenth Subspecies.

Flinty-Slate.

THIS subspecies is divided into two kinds, viz. Common Flinty-Slate, and Lydian-Stone.

First

*First Kind.*Common *Flinty Slate*.Gemeiner Kieselchiefer, *Werner*.

Id. Wid. s. 380.—Siliceous Schistus, *Kirm.* vol. i. p. 306.—Kieselchiefer, *Estner*, b. ii. s. 343. *Id. Emm.* b. i. s. 178.—Schisto silicea, *Nap.* p. 244.—Schiste silicieux commun, *Broch.* t. i. p. 283.—Gemeiner Kieselchiefer, *Reuss*, b. ii. s. 332. *Id. Lud.* b. i. s. 84. *Id. Mohs*, b. i. s. 259. *Id. Bert.* s. 168. *Id. Suck.* 1st th. s. 361.—Jaspe schisteux, *Brong.* t. i. p. 327.—Gemeiner Kieselchiefer, *Steffens*, b. i. s. 175. *Id. Hoff.* b. ii. s. 75. *Id. Lenz*, b. i. s. 373. *Id. Oken*, b. i. s. 297. *Id. Haus.* Handb. b. ii. s. 400.—Indurated Slate, *Aikin*, p. 244.

External Characters

Its principal colour is grey, and most frequently ash-grey. It passes on the one side into smoke-grey and greyish-black, on the other into pearl-grey, from which it passes into flesh-red, and into a colour intermediate between brownish-red and cherry-red.

The colours sometimes occur in flamed and striped, also in spotted and clouded delineations.

It is often traversed by quartz veins.

It occurs massive, in mountain masses, and in blunt-edged pieces, which are pebbles.

It sometimes occurs in lamellar concretions.

Internally it is faintly glimmering, almost dull.

The fracture in the great is slaty, and in the small splintery.

The fragments are indeterminate angular, and more or less sharp-edged, and sometimes tabular.

It is more or less translucent, and passes into translucent on the edges.

It is hard.

It is uncommonly difficultly frangible.

Specific gravity, 2.613, 2.628, 2.644, *Hoffman*.—2.641, *Kirwan*.

Chemical Characters.

It is to be regretted that this interesting substance has not been hitherto chemically examined.

Geognostic Situation.

It occurs in beds and imbedded masses in clay-slate and grey-wacke; and in roundish and angular masses in sandstone.

Geographic Situation.

It occurs in different parts of the great tract of clay-slate and grey-wacke, which extends from St Abb's Head to Port Patrick; also in the Pentland Hills near Edinburgh.

It is also found in Norway, Saxony, Bohemia, Silesia, France, and other countries.

Observations

1. It is distinguished from *Splintery Hornstone*, with which it has been confounded, by its colours being in general darker, its glimmering internal lustre, its slaty fracture, its lamellar concretions, and its geognostic relations. Colour, lustre, translucency, and more difficult frangibility, distinguish it from *Lydian-stone*.

2. In early writings it is named Horn-Slate, (*Hornschiefer*); under which denomination mineralogists included a variety

[Subsp. 10. *Flinty Slate*,—2d Kind, *Lydian Stone*.

variety of slaty rocks, as Porphyry-slate, and Greenstone. Werner first accurately described it, and gave it its present name and place in the system.

3. It is very nearly allied to the *horn-rock* of some mineralogists, which is an intimate mixture of quartz and felspar.

Second Kind.

Lydian-Stone *.

Lidischerstein, *Werner*.

Lapis Lydius, (s. Heraclius,) *Plin.* Hist. Nat. xxxiii. 8.—Lapis Lydius, *Wall.* t. i. p. 353.—L. Stein, *Wid.* p. 360.—Basanite, *Kirw.* vol. i. p. 307.—Lidischerstein, *Estner*, b. ii. s. 346. *Id.* *Emm.* b. i. s. 181.—Schisto silicea, *Nap.* p. 244.—Lydienne, *Lam.* t. ii. p. 384.—La pierre de Lydie, *Broch.* t. i. p. 286.—Lydischerstein, *Reuss*, b. ii. s. 337. *Id.* *Lud.* b. i. s. 85. *Id.* *Mohs*, b. i. s. 262. *Id.* *Bert.* s. 168. *Id.* *Suck.* 1^{re} th. s. 363.—Jaspisartiger Kieselschiefer, *Hab.* s. 13.—Jaspe schisteux, *Brong.* t. i. p. 328.—Lydischerstein, *Steffens*, b. i. s. 176. *Id.* *Hoff.* b. ii. s. 79.—Lydit, *Lenz*, b. i. s. 374. *Id.* *Oken*, b. i. s. 297.—Jaspisartiger Kieselschiefer, *Haus.* b. ii. s. 400.—Lydian-stone, *Aikin*, p. 244.

External Characters.

Its colour is greyish-black, which passes into velvet-black.

It occurs massive, and also in trapezoidal-shaped rolled pieces, which have smooth and glistening surfaces.

It

* So named from Lydia in Asia Minor, where it was first observed. It is described in Pliny and Theophrastus by its present name.

It is, like the preceding kind, traversed by quartz veins. Internally it is glimmering.

The fracture is generally even, and approaches sometimes to flat conchoidal.

The fragments are indeterminate angular, more or less sharp-edged, and sometimes approach to the cubical shape.

It is opaque.

It is hard, but not in so high a degree as flint.

It is rather difficultly frangible.

Specific gravity, 2.596, *Kirwan*.—2.629, *Karsten*.—2.585, *Hoffmann*.

Geognostic Situation.

It occurs very frequently along with common flinty-slate in beds in clay-slate; but it has not been found in any of the older primitive rocks. It occurs in masses of various sizes, imbedded in grey-wacke, and in beds that alternate with strata of that rock. A rock very nearly allied to it occurs in beds in the oldest coal formation, viz. that associated with the old red sandstone, and in some newer coal formations.

Geographic Situation.

It is found near Prague and Carlsbad in Bohemia; at Hainchen near Freyberg in Saxony; in the Hartz; and in the Moorfoot and Pentland Hills, near Edinburgh.

Use.

This mineral is sometimes used as a touchstone, for ascertaining the purity of gold and silver. When we wish to determine the relative purity of different kinds of gold and silver alloys, we draw the alloy across the surface of
the

the stone, and compare the colour of its trace with that of the pure metals, or of known compounds of these metals, and we thus obtain by simple ocular inspection a pretty correct knowledge of the purity of the alloy.

A good touchstone should be harder than the metals or metallic compounds to be examined: if softer, the powder of the stone mixes with the trace of the metal, and obscures it. It must also possess a certain degree of roughness on its surface, in order that the metal may leave a sufficiently distinct trace or streak; it must not, however, be too rough, otherwise the particles of the metal will be hid amongst inequalities, and no distinct or continuous trace will be formed.

Lastly, a good touchstone must have a black colour, as this tint shews the colour of the streak better than any other.

Those varieties of *Lydian-Stone* which are neither too hard nor too soft, and which have a kind of velvety feel, and are not traversed by quartz veins, are those which are preferred for touchstones.

They are cut into tables by means of pumice; then ground with sandstone, and, lastly, rubbed with charcoal-powder or ivory-black.

Observations.

1. Compact varieties of Clay-slate and of Basalt are sometimes used as touchstones.

2. According to Humboldt, it contains a small portion of carbon.

Eleventh Subspecies.

Flint.

Feurstein, *Werner*.

Silex igniarius, *Wall.* t. i. p. 275.—Feurstein, *Wid.* p. 308.—
 Flint, *Kirn.* vol. i. p. 301.—Feurstein, *Estner*, b. ii. s. 360.
Id. Emm. b. i. s. 143.—*Pietra focacia*, *Nap.* p. 180.—*Silex*, ou
 Pierre à fusil, *Lam.* t. i. p. 137. *Id. Broch.* t. i. p. 268.—
 Quarz-agathe pyromaque, *Haüy*, t. ii. p. 427.—Feurstein,
Reuss, b. ii. s. 295. *Id. Lud.* b. i. s. 79. *Id. Suck.* 1^{re} th.
 s. 343. *Id. Bert.* s. 260. *Id. Mohs*, b. i. s. 264. *Id. Hab.* s. 9.
Silex pyromaque, *Brong.* t. i. p. 313.—Quartz-agathe pyro-
 maque, *Lucas*, p. 33. *Id. Brard*, p. 96.—Black Flint, *Kid*,
 vol. i. p. 211.—Feurstein, *Steffens*, b. i. s. 163. *Id. Hoff.* b. ii.
 s. 83. *Id. Lenz*, b. i. s. 377. *Id. Oken*, b. i. s. 265. *Id. Haus.*
 b. ii. s. 404.—Flint, *Aikin*, p. 182.

External Characters.

Its most common colour is grey, of which the following varieties occur: ash-grey, yellowish-grey, and smoke-grey. From smoke-grey it passes on the one side through ash-grey, into greyish-black; on the other, into yellowish-grey, and into a colour intermediate between ochre and wax-yellow; further, into yellowish-brown, reddish-brown, and into a colour intermediate between blood-red and brownish-red.

It sometimes presents zoned, striped, clouded, spotted, and flamed colour delineations.

Besides massive, in regular plates, in angular grains and pieces; it occurs also in globular and elliptical rolled pieces, in the form of sand, and tubercle and perforated.

It

It sometimes, although rarely, occurs in supposititious crystals. These are :

1. Acute double six-sided pyramid.
2. Flat single or double three-sided pyramid.
3. Six-sided prism, very flatly acuminate by three planes, which are set on the alternate lateral planes.
4. Table.

These crystals are internally hollow : the pyramidal and prismatic forms originate from calcareous spar ; the tabular from heavy spar.

It occurs in extraneous external shapes, viz. in the form of echinites, corallites, madreporites, fungites, belemnites, mytilites, &c. : of these, the echinites are the most frequent, and the mytilites the rarest.

It sometimes occurs in lamellar concretions, which are either straight or concentrically curved.

The external surface of the angular pieces is smooth and glistening, that of the other forms is sometimes rough, sometimes uneven.

Internally its lustre is glimmering.

The fracture is perfect and large, and rather flat conchoidal.

The fragments are indeterminate angular, and very sharp-edged.

It is translucent ; the blackish varieties are seldom more than translucent on the edges.

It is hard ; rather harder than quartz.

It is easily frangible.

Specific gravity, 2.594, *Blumenbach*.—2.581, *Geller*.—2.581, *Brisson*.—2.594, 2.592, *Hoffmann*.—2.580, 2.630, *Kirwan*.

Chemical Characters.

Before the blowpipe it is infusible without addition ; but whitens and becomes opaque.

Constituent Parts.

Silica,	-	98.0	98.
Lime,	-	0.50	0.50
Alumina,	-	0.25	0.25
Oxide of Iron,		0.25	0.25
Loss,	-	1.00	1.
		<hr/>	<hr/>
		100	100

Klaproth, Beit. b. i. s. 46.

Vauquelin, Journ. de
Mines, n. xxxiii.
p. 702.

Physical Characters.

When two pieces of flint are rubbed together in the dark, they phosphorise very much, and emit a peculiar smell.

Geognostic Situation.

1. It occurs in primitive, transition, secondary, and alluvial rocks. In primitive and transition rocks, it occurs in metalliferous and agate veins. The metalliferous veins contain in some instances ores of silver or of cobalt, in others ores of iron ; and the agate veins are composed of flint, calcedony, jasper, amethyst and quartz. In secondary countries, where this mineral occurs in greatest abundance, it is found in sandstone, limestone, chalk, and amygdaloid. The sandstone is that variety known under the name of *Puddingstone* ; the limestone is one of the newer secondary rocks,
in

in which the flint appears in beds, imbedded masses, and veins: in chalk it occurs in great abundance in beds, also imbedded in angular and tuberoso-shaped masses, and in various extraneous shapes: and in amygdaloid it forms one of the constituent parts of agate, or occurs in veins. In alluvial country, it appears in the form of rolled masses, or gravel, and sometimes as coarse sand.

2. The imbedded masses of flint are frequently hollow, and the walls of the cavities are lined with crystals of quartz, and sometimes with crystals of sulphur.

3. The beds of flint, and also the tuberoso and other shaped masses of this mineral, found in chalk, appear to have been formed at the same time with the chalk. But Werner is of opinion, that the tuberoso, and many other forms, have been formed by infiltration: he conjectures, that during the deposition of chalk, air was evolved, which, in endeavouring to escape, formed irregular cavities, that were afterwards filled up, by infiltration, with flint.

4. It is often covered with a whitish crust, which is usually produced by weathering; but in other instances, appears to be an original formation.

Geographic Situation.

Europe.—In Scotland it occurs imbedded in secondary limestone in the island of Mull, and near Kirkaldy in Fifeshire; and in veins and agates in primitive and secondary rocks in various parts of the country. In England, it abounds in alluvial districts in the form of gravel; or is imbedded in chalk, or secondary limestone, and forms a constituent part of veins that traverse both primitive and secondary rocks.

In Ireland it occurs in considerable quantity in secondary limestone.

On the Continent of Europe it is not unfrequent; thus it occurs imbedded in chalk in the islands of Rugen and Zeeland; in secondary limestone in Swabia, Bavaria, Saxony, Prussia, Franconia, Austria, Galicia, France, Spain, and Switzerland.

Asia.—In the Uralian mountains it occurs in beds in secondary limestone; also in veins that traverse both primitive and secondary rocks. It has been found on the shores of the lake Baikal; and on the banks of the river Tura, also in Siberia; and in different parts of China.

America.—It occurs in North America, either imbedded in rocks, or in rolled pieces.

Uses.

The principal use of this mineral is for gun-flints, for which purpose it is excellently fitted, on account of its hardness, the abundance of sparks it affords with steel, and the sharp fragments it gives in breaking*. The most celebrated manufactories of gun-flints are those in England, Muesnes near Berry in France, in Galicia, and of Avio in the Tyrol. The operation of making them is so simple and easy, that a good workman will make 1500 flints in a day. The whole art consists in striking the stone repeatedly with a kind of mallet, and breaking off at each stroke a fragment, sharp at one end, and thicker at the other. These fragments are afterwards shaped at pleasure, by laying the line at which it is wished they should break, upon a sharp iron instrument, and then giving it repeatedly smart blows with a mallet. During the whole operation, the workman holds the stone in his left hand, or merely supports it on his knee. All the varieties of flint

* Flint was first used as for muskets in the year 1670.

flint are not equally well fitted for gun-flints; the best are the yellowish-grey; the dark smoke and ash grey varieties are also used, but they are neither, so easily split, nor do they afford such thin fragments as the other, and, owing to their greater hardness, they wear the lock sooner. In Prussia, an attempt was made to substitute a kind of porcelain for flint, and such flints were for some time used by the Prussian soldiers. In ancient times, flint was fashioned into cutting instruments; and it is conjectured that the stone knives used by the Hebrews for circumcision were of this mineral; and hence probably also originated the word *Silex*, which is derived from *scindere*. It also forms a principal ingredient in that species of pottery named *Flint-ware*; it is used as a mill-stone, particularly in smalt works; sometimes it is employed as a building-stone; and by chemists for mortars.

Observations.

1. Flint is distinguished from *Common Calcedony*, by its colour suite, glimmering lustre, perfect conchoidal fracture, inferior translucency, and inferior hardness.
2. It passes into Hornstone, Carnelian, Calcedony, and even into a kind of Flinty-slate.
3. It occurs frequently in extraneous external shapes, a character which distinguishes it from *Hornstone*.
4. Hacket has endeavoured to shew that it originates from chalk, and is daily forming.
5. Flint, when dug out of its repository, is very generally enveloped in a thin white opaque crust: if this crust be removed, and the flint exposed to the influence of the weather, it will, in the course of time, become opaque, and of a whitish colour.

*Twelfth Subspecies.***Calcedony*.****Kalzedon, Werner.**

THIS subspecies is divided into four kinds, viz. Common Calcedony, Chrysoprase, Plasma, and Carnelian.

*First Kind.***Common Calcedony.****Gemeiner Kalzedon, Werner.**

Achates chalcedonius, *Wall.* t. i. p. 287.—Calcedoine, *Romé de Lisle*, t. ii. p. 145.—Gemeiner Chalzedon, *Wid.* p. 317.—Common Calcedony, *Kirn.* vol. i. p. 298.—Chalcedon, *Estner*, b. ii. s. 368. *Id. Emm.* b. i. s. 151.—Calcedonia, *Nap.* p. 183.—La Calcedoine, *Lam.* t. ii. p. 142. *Id. Broch.* p. 268.—Quartz-agathe calcedoine, *Häuy*, t. ii. p. 425.—Gemeiner Chalcedon, *Reuss*, b. ii. p. 271. *Id. Lud. Suck. Bert. Id. Mohs*, b. i. s. 273. *Id. Karst.* Tabel. s. 24. *Id. Leonhard*, Tabel. s. 10.—Quartz-agathe calcedoine, *Lucas*, p. 33.—Silex calcedoine, *Brong.* t. i. p. 298.—Quartz agathe calcedoine, *Brard*, p. 96.—Calcedony, *Kid*, vol. i. p. 217.—Calcedoine, *Häuy*, Tabl. p. 26.—Gemeiner Kalcedon, *Steffens*, b. i. s. 153. *Id. Hoff.* b. ii. s. 108. *Id. Lenz*, b. i. s. 385.—Chalcedon, *Oken*, b. i. s. 266.—Chalcedony, *Aikin*, p. 179.

External Characters.

Its most common colour is grey, of which the following varieties

* Calcedony, in antient times, was collected principally in the district of Calcedonia in Asia Minor, and hence its name.

[Subsp. 12. *Calcedony*,—1st Kind, Common *Calcedony*.

varieties occur; smoke-grey, bluish-grey, pearl-grey, greenish-grey, and yellowish-grey. The bluish-grey passes into milk-white *, and smalt-blue; the pearl-grey, into pale violet-blue and plum-blue; the greenish-grey into a colour which is intermediate between grass and apple green; the yellowish-grey passes into honey-yellow †, wax-yellow, and ochre-yellow: from this into yellowish-brown, blackish-brown, and brownish-black ‡.

The two last-mentioned colours are very dark, and when held between the eye and the light appear blood-red.

The colours occur in clouded, striped ||, dendritic and moss-like delineations.

Those varieties, in which there is an alternation of white, black, and dark-brown layers are named *onyx*; those with white and grey layers, *calcedonyx*. The dendritic varieties, which have a white or grey basis, with black, brown, or green arborisations, are named *Mocha-stones* *.

The bluish-grey varieties, in concentric lamellar concretions, when cut across into thin tables, and held between the eye and the light, exhibit an iridescent appearance, and hence have been named *rainbow calcedony*. When cut parallel to the concretions, they exhibit a clouded delineation.

It

* *Leucachates* of Pliny.

† *Cerachates* of Pliny.

‡ The green and blue varieties are the rarest. M. De Dree mentions an *azure-blue* variety, under the name of *sapphirine*, and which is much prized on account of its beauty and rarity. It is found in Transylvania, and at Nertschinski in Siberia.

|| The variety with green stripes, named *Memphites*.

§ *Mocha-stone*, also named *Dendritic calcedony*.

It occurs massive, in blunt-edged pieces, smooth rolled pieces, plates, crusts, balls, (which sometimes contain water, forming what are called *enhydrites*, and more rarely, as at Irkutsk, mineral oil), reniform, botryoidal, coralloidal, stalactitical, cellular, with impressions (generally from cubes of fluor-spar), and crystallized.

The following are its crystallizations :

True Crystals.

1. Rhomboid, in which the sides are either drusy or granulated, with a glimmering lustre. They occur in druses.

Supposititious Crystals.

1. Rhomboid, from calcareous-spar.

It sometimes occurs also in extraneous external shapes, in the form of ammonites, turbinites, echinites, madreporites, and of petrified wood.

It occurs in lamellar distinct concretions, varying in thickness, and which are sometimes reniformly curved, sometimes globular and concentrically curved ; and very rarely it is disposed in fibrous concretions, which are again collected into coarse, long, angulo-granular concretions.

Internally it is dull ; the splintery varieties exhibit a faint degree of lustre.

The fracture is even, which sometimes passes into imperfect and flat conchoidal, and splintery.

The fragments are indeterminate angular, and rather very sharp-edged.

It

It is generally semitransparent; but the black and white varieties are only translucent.

It is hard; rather harder than flint.

It is brittle.

It is easily frangible.

Specific gravity, 2.600 to 2.655, *Kirwan*.—2.615, *Blumenbach*.—2.618, 2.643, *Karsten*.—2.583, 2.586, *Hoffman*.—2.664, *Brisson*.

Chemical Characters.

Infusible before the blowpipe without addition

Constituent Parts

Silica,	-	-	99
Loss,	-	-	1
			100 <i>Tromsdorf</i> *

Geognostic Situation.

It occurs in primitive, secondary and alluvial rocks, in balls, kidneys, angular pieces, short and thick beds, veins, and rolled pieces. The balls and kidneys occur most frequently in secondary amygdaloid, and contain, besides the calcedony, also flint, &c. and in their interior exhibit beautiful reniform, botryoidal, stalactitical, and other particular external shapes. The angular pieces are most frequent in secondary amygdaloid; they occur also in primitive porphyry. The beds occur in primitive porphyry, but more abundantly, in

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secondary

* In the early analysis of Bergman, Gerhard and Lampadius, alumina, in the proportion of from 12 to 16 per cent. is stated as occurring in calcedony; and Guyton and Bindheim mention lime as one of its constituent parts.

secondary trap rocks, as in amygdaloid, basalt, and greenstone. The veins are of two kinds: agate veins, which occur in primitive, and secondary rocks; and metalliferous veins, that occur principally in primitive rocks. The agate veins contain, besides the calcedony, also flint, hornstone, opal, and amethyst. The metalliferous veins are of three formations: In the first, the calcedony is associated with silver and lead ores, and brown-spar, as in the Saxon Erzgebirge; in Lower Hungary, and Transylvania: In the second, with brown and black ironstone, sparry ironstone, hornstone, and other fossils, as in the Saxon Erzgebirge; in Voightland; at Huttenberg, in Carinthia, &c.: And in the third, along with ores of copper, as in the Trevascus mine, in Cornwall. The calcedony in these veins exhibits many different external forms, as stalactitical, botryoidal, coralloidal, reniform, &c. In alluvial country, it is found only in rolled pieces.

Geographic Situation.

Europe.—This mineral occurs more or less frequently in the secondary trap rocks of Scotland. Thus, it forms cotemporaneous veins in greenstone rocks in Fifeshire; and occurs in balls, kidneys, and veins, either singly or along with other minerals forming agate, in the trap rocks of the Pentland Hills, near Edinburgh, those in West Lothian, Mid Lothian, East Lothian, Dumfriesshire, Lanarkshire, Dumbartonshire, Stirlingshire, Perthshire, Angusshire, and other districts in the mainland of Scotland. The trap rocks of Mull, Rume, Canna, Eigg and Skye, afford calcedony; and small portions of it occur in the trap rocks of Shetland. The most singular varieties of English calcedony are those found in Trevascus mine, in Cornwall. It abounds in the amygdaloidal rocks of the island of Iceland.

[*Subsp. 12. Calcedony,—1st Kind, Common Calcedony.*

land and the Faroe islands. It is a rare mineral in the Scandinavian peninsula; and occurs more or less frequently in the Hartz; in the Electorate of Saxony; Silesia; Bohemia; Franconia; Suabia; Galicia; France; Switzerland; Italy; Austria; Hungary; and Transylvania.

Asia.—It occurs in rolled pieces in the island of Ceylon; in the trap rocks of Dauria; in Calmuck Tartary; in the Altain and Uralian mountains; and on the shores of the sea of Ochotsk.

Africa—It occurs in rolled pieces on the banks of the river Nile. The ancients are said to have procured their finest calcedonies from mountains in the neighbourhood of Thebes.

America.—It occurs in Greenland; in different parts of the United States, in porphyry and amygdaloid; in Mexico; and at Panama, in New Granada, in South America.

Uses.

As it is hard, susceptible of a fine polish, and exhibits beautiful colours, and considerable transparency, it is employed as an article of jewellery. It is cut into ring and seal stones, necklaces, ear-drops, small vases, cups, and snuff-boxes. The finer varieties, particularly those named Onyx, were much prized by the ancients, and were by them cut into cameas.

✱ The Camea is a kind of engraving in relief, in which the figure is of a different colour from the ground. When the colours are good, and distinctly separated from each other, and the layers equal and parallel, the onyx is much prized. Many fine engraved cameas of this kind are preserved in collections. The National Museum in Paris, and

the magnificent collection of M. De Drec, also in Paris, are rich in cameas.

The concentrically striped onyxes, which are very rare, were much prized by the ancients, and they cut upon them very beautiful figures in demi-relief*. One of the most beautiful works cut in this variety of calcedony, is the celebrated *Mantuan Vase*, which was seized by the Germans at the storming of Mantua, and ever since has been preserved in the Ducal Collection in Brunswick. Several beautiful plates of onyx are preserved in the Electoral Cabinet in Dresden: there is one valued at 41,000 dollars.

The dendritic calcedonies, or mocha-stones, are much prized as ornamental stones. The arborizations, as already mentioned, are black, red, brown, or green. The black are the most common, and most distinct: the red, on the contrary, are rarer, and are less distinct, and are named *corallines*, from the resemblance of the dendritic delineations to coral; and the green are rare, and much esteemed. These arborizations appear in some cases to be owing to iron, in others to manganese, iron, and mineral oil. Du-
tens,

* Some antiquarians are of opinion, that the *vasa murrina* of Pliny were of onyx; but Dr Clarke, in the following passage, advances another hypothesis "The porcelain of China," he observes, "brought overland on the backs of camels, is exposed for sale in Grand Cairo, Smyrna, and Constantinople. We saw some porcelain dishes for containing pilau, that had been thus conveyed, and they were a yard in diameter. The same trade with China existed in the time of the Romans; and at the introduction of the porcelain vessels into Rome, they were bought at enormous prices, and were esteemed by the Romans of the Augustan age as articles of the highest luxury and magnificence. These were the *vasa murrina* of Pliny, as may be proved from Belon, who says, that the Greeks called them in his time "La mirrhe de Smirna," from *murex*, a shell called by the French *Porcelain shell*; the fine vitrified superficies of porcelain resembling in its lustre and polish the surface of the *Murex*."—*Clarke's Travels*.

(Subsp. 12. *Calcedony*,—1st Kind, *Common Calcedony*.

tens *, Von Moll, Daubenton, and lately Lenz, Blumenbach, and Dr MacCulloch, maintain that many of them are of a true vegetable nature. Dutens says, that if the plants contained in calcedony are extracted, and the fragments thrown on burning charcoal, a bituminous smell is exhaled; and Von Moll maintains, that calcedony sometimes contains brown and green moss.

Lenz affirms, that the calcedony found in the amygdaloid of Deuxponts contains *musci* of different kinds, such as lichen *rangiferinus*, *confervæ*, *byssi*, and *brya*. And Blumenbach says, in a letter to Baron Von Moll, that though he had hitherto disbelieved the occurrence of vegetable bodies in the dendritic variety of calcedony named *mocha-stone*, he must now admit that it does sometimes contain plants, apparently of the nature of *conferva*. He observed these in specimens from Iceland and Catherinenburg. The same celebrated naturalist maintains, that he found, in the interior of an agate, the fructification of an unknown plant, somewhat resembling the *Sparganium erectum*. Dr MacCulloch, after examining several hundred specimens of *mocha-stone*, is of opinion that they contain *cryptogamous plants* †. This opinion, however, still remains very improbable.

Observations.

1. Its dull and even fracture distinguish it from *Flint*; and the same characters distinguish it from *Carnelian*.

2. It passes into *Opal* and *Flint*; probably also into *Hyalite*.

3. It

* Vid. *Traité des Pierres Precieuses*, p, 70, 71.

† Vid. *Geological Transactions*, for Dr MacCulloch's observations on this subject.

8. It was first accurately described by Werner.

4. The dendritic variety is supposed to have been originally brought from Arabia, by the way of Mocha; and hence the name *Mocha-stone* given to it by jewellers.

TABULAR VIEW of the names given to different varieties of COMMON CALCEDONY.

1. *Leucachates* of Pliny, milk-white calcedony.
2. *Cerachates* of Pliny, honey-yellow calcedony.
3. *Sapphirine*; azure-blue calcedony.
4. *Onyx*; calcedony, in which there is an alternation of white, black, and dark-brown layers.
5. *Calcedonyx*. In this variety there are but two shades of colour, viz. white and grey, which are also disposed in layers.
6. *Mocha-stone*, or *Dendritic Calcedony*. In this variety beautiful arborizations are distributed through a white or grey ground.
7. *Memphites*; grey calcedony with green stripes.
8. *St Stephen's stone*; calcedony with small red points of carnelian or jasper. It ought rather to be placed with agate, but the common arrangement is here followed. It was formerly much esteemed.

Second

*Second Kind.***Chrysoprase*.**Krisopras, *Werner*.

Achatz-prasius, *Wall.* t. i. p. 292.—Chrysoprase, *Romé de Lisle*, t. ii. p. 167.—Krisopras, *Wern. Cronst.* p. 99. *Id. Wid.* p. 336.—Chrysoprasium, *Kirm.* vol. i. p. 284.—Crysopras, *Estner*, b. ii. s. 349. *Id. Emm.* b. i. s. 174.—Crisoprasio, *Nap.* p. 195. *Id. Lam.* t. ii. p. 177.—La Chrysoprase, *Broch.* t. ii. p. 280.—Quartz-agathe prase, *Haiiy*, t. ii. p. 426.—Crysoprase, *Reuss*, b. ii. s. 270. *Id. Lud. Suck. Bert.* *Id. Mohs*, b. i. s. 304. *Id. Hab.* *Id. Karst.* Tabel. *Id. Leonhard*, Tabel.—Silex Chrysoprase, *Brong.* t. i. p. 298.—Quartz-agathe prase, *Lucas*, p. 33. *Id. Brard*, p. 96.—Chrysoprase, *Kid*, vol. i. p. 204.—(Quartz-agathe prase, *Haiiy*, Tabl. p. 26.—Chrysopras, *Hoff.* b. ii. s. 98. *Id. Steffens*, b. i. s. 157. *Id. Lenz*, b. i. s. 395. *Id. Oken*, b. i. s. 272. *Id. Aikin*, p. 180.

External Characters.

Its characteristic colour is apple-green, of all degrees of intensity; it passes into pale grass-green, pistachio-green, and greenish-grey. It is sometimes spotted yellowish-brown.

It occurs generally massive, and sometimes in plates.

Internally

* The name *Chrysoprase* (*χρυσοπράσιος*, *Chrysoprasus*) is derived from the Greek, and was applied to a mineral having a yellowish-green colour. We are ignorant of the stone which the ancients described under this name. Lehman was the first who applied it to the green stone of Rosemount.—Vid. *Histoire de l'Académie Royale des Sciences et Belles Lettres*, année 1755; Berlin, 1757, p. 202.—Vid. also Meinecke's Monograph, intitled, *Ueber den Chrysoprase*; Erlangen, 1805.

Internally it is dull, seldom glimmering.

Its characteristic fracture is even; some varieties run into small and fine splintery; others, very rarely, into flat conchoidal.

The fragments are indeterminate angular, and more or less sharp-edged.

It is intermediate between translucent and semi-transparent, but always approaches more to the first.

It is rather softer than calcedony or flint.

It is rather difficultly frangible.

Specific gravity, 2.600, *De La Metherie*.—2.714. *Karsten*.—2.608, *Hoffmann*.—3.250? *Klaproth*.

Chemical Characters.

Before the blowpipe it loses its colour and transparency, and is infusible without addition.

Constituent Parts.

Silica,	-	-	96.16
Lime,	-	-	0.83
Magnesia,	-	-	0.08
Alumina,	-	-	00.8
Oxide of Iron,	-	-	0.08
Oxide of Nickel,	-	-	1.00
			<hr/>
			100

Klaproth, *Beit*, t. ii. p. 133.

Geognostic Situation.

It occurs in plates and contemporaneous veins, along with quartz, hornstone, common calcedony, semi-opal, asbestos, indurated talc, lithomarge, green-earth, and steatite, in primitive serpentine.

Geographic

Geographic Situation.

It has hitherto been found only in the Principality of Munsterberg, in Lower Silesia, in the vicinity of the towns of Glassendorf, Grochau, and Kosemitz.

Uses.

This gem is much prized by jewellers. The colour, when deep and pure, is very agreeable to the eye, and when contrasted with brilliants and pearls, particularly by candle light, is very beautiful. It is generally cut into a convex form, or what jewellers call *en cabochon*. It is sometimes cut into ring-stones, necklaces, bracelets, ear-drops and brooches, and, when set, green taffeta is used as a foil. In ornamental dress, it is found to harmonize with diamonds and pearls. Ring-stones of chrysoprase, when semi-transparent, and of a pure apple-green colour, will sell at from ten to twenty guineas. Its colour fades when kept long in a warm and dry place, or when much exposed to the air: on this account it is recommended to keep it in moist cotton. As the colouring substance of this mineral is nickel, it is difficult to explain the change of colour just mentioned. It requires considerable attention in cutting, as it is very apt to fly in pieces; and lapidaries find that great care also must be used in polishing it, for, if the wheel is driven too fast, and the gem is overheated, it becomes whitish and muddy.

The larger and impure masses are cut into snuff-boxes, seal-stones, and similar articles. Very beautiful plates of chrysoprase are to be seen in the Cathedral Church in Prague.

Observations.

1. Its distinguishing characters are its apple-green colour, even and dull fracture, semi-transparency, and hardness. Colour, and inferior hardness distinguish it from *Common Calcedony*; and the dull even fracture, with greater hardness, and weight, are the characters by which it is distinguished from *Opal*. Some observers have confounded it with *Prase*, from which it is readily distinguished by colour, the want of lustre, even fracture, greater transparency, hardness, and weight.

2. It passes into *Opal* and *Splintery Hornstone*.

Third Kind.

Plasma*.

Plasma, *Werner*.

Id. Emm. b. iii. s. 322. *Id. Broch.* t. i. p. 278. *Id. Renss.* b. ii. s. 286. *Id. Lud. Suck. Bert.* *Id. Mohs*, b. i. s. 308. *Id. Karst. Tabel.* *Id. Leonhard, Tabel.* *Id. Hab.* *Id. Kid*, vol. i. p. 205. *Id. Steffens*, b. i. s. 159. *Id. Lenz*, b. i. s. 395.—Quartz-agathe calcedoine vert obscur, *Lucas*, t. ii. p. 110.—Plasma, *Hoff.* b. ii. s. 103.

External Characters.

Its most common colour is a variety intermediate between grass-green and leek-green, and sometimes approaching to pale mountain-green. It frequently occurs greenish-white and ochre-yellow: the latter colour is in dots; the first in spots, or clouded.

It

* This mineral has been known under its present name in Italy for some hundred years. It is conjectured to be a corruption of *Prasine* or *Prasina*, the names given by Italian mineralogists to green-coloured minerals, such as prase and chrysoprase.

It occurs in angular pieces.

Internally its lustre is glistening, inclining to glimmering.

The fracture is imperfect, and rather flat conchoidal.

The fragments are indeterminate angular, and very sharp-edged.

It is translucent, inclining to semi-transparent.

It is hard.

It is brittle.

It is rather easily frangible.

Specific gravity, 2.553, *Klaproth*.—2.445? *Karsten*.

Chemical Characters.

It is infusible before the blowpipe, but loses its colour.

Constituent Parts.

Silica,	-	-	96.75
Alumina,	-	-	0.25
Iron,	-	-	0.50
Loss,	-	-	2.50
			<hr/>
			100

Klaproth, *Beit. b. iv. s. 326*.

Geognostic and Geographic Situations.

It occurs in beds, associated with common calcedony. Most of the specimens in cabinets, have been collected among the ruins of Rome. It occurs also at Prussa, at the foot of Mount Olympus, in Asia Minor, where it is associated with the green calcedony of *Klaproth*, which is only a variety of *plasma*; and it has been lately found at Guadalupe, about a league from Mexico, where it occurs in beds, along with calcedony.

Use.

Uses.

It was considered by the Romans as a gem, and was cut into ornaments; and frequently figures were engraved upon it.

Observations.

1. It is distinguished from *Heliotrope* by colour, inferior lustre, and weight, and also by its greater transparency: it is distinguished from *Chrysoprase* by colour, greater lustre, perfect conchoidal fracture, and greater weight; and its fracture distinguishes it from *Common Calcedony*.

2. It has been known for several centuries in Italy under the name *Plasma*, but was first introduced into the system by Werner.

3. It is the *Prime d'Emeraude* of some authors; and would appear to have been described by Pliny as a variety of his *smaragdus*.

Fourth Kind

Carnelian

Carneol, Werner.

Sarda, *Plin. Hist. Nat.* xxxvii. 7.—Achates carneolus, *Wall.* t. i. p. 185.—Cornaline, *Romé de Lisle*, t. ii. p. 146.—Blutrothe, Kalzedon, *Wid.* p. 318.—Carnelian, *Kirw.* vol. i. p. 300.—Karniol, *Emm.* b. i. s. 157.—Carniola, *Nap.* p. 185.—Agathe Cornaline, *Lam.* t. ii. p. 147.—La Cornaline, *Broch.* vol. i. p. 272.—Quartz-agathe cornaline. *Haüy*, t. ii. p. 425.—Karneol,

* The name *Carnelian* does not occur either in Theophrastus or Pliny, that mineral being described by these naturalists as a red variety of Sarda. Carnelian, therefore, is of more modern date, and is supposed to be derived from the Latin words *caro* or *carneus*, which may have been given to it on account of its flesh-red colour.

neol, *Reuss*, b. ii. s. 282. *Id. Suck. Lud. Bert. Id. Mohs*, b. i. s. 298. *Id. Karst. Tabel. Id. Leonhard, Tabel.*—*Silex coralline*, *Brong.* t. i. p. 296.—*Quartz-agathe coralline*, *Lucas*, p. 33. *Id. Brard*, p. 96. *Id. Haiiy*, Tabl. p. 26.—*Karneol*, *Steffens*, b. i. s. 160. *Id. Hoff.* b. ii. s. 118. *Id. Lenz*, b. i. s. 391. *Id. Oken*, b. i. s. 266. *Id. Haus. Handb.* b. ii. s. 406. —*Carnelian*, *Aikin*, p. 180.

External Characters.

Its principal colour is blood-red, of all degrees of intensity: the dark varieties sometimes incline to reddish-brown; but the paler varieties pass into flesh-red, and reddish-white, and also into a colour intermediate between ochre and wax yellow. It also occurs sometimes milk-white, and olive-green. It generally has but one colour; sometimes, however, it exhibits concentrically striped delineations, or fortification or red dendritic delineations.

It occurs sometimes in rolled pieces, which appear to have been original balls: sometimes in thin layers in agate; very seldom kidney-shaped. The surface of the rolled pieces is rough, and reddish-brown.

It occurs in fibrous concretions, which are straight, scoopiform, closely aggregated, and collected into long and wedge-shaped prismatic and lamellar concretions.

The fracture is perfect conchoidal, or splintery in the uniform varieties.

The lustre is glistening, sometimes passing into shining, and is vitreous.

The fragments are indeterminate angular, and sometimes splintery.

It is generally semi-transparent; seldom translucent.

It is hard, but in a lower degree than common calcedony and flint.

Specific gravity, 2.594, 2.630, *Brisson*.

Chemical

Chemical Characters.

It is infusible without addition.

Constituent Parts.

Silica,	-	-	94
Alumina,	-	-	3.50
Iron,	-	-	0.75

100 *Bindlicim.*

Geognostic and Geographic Situations.

It frequently occurs as a constituent part of agate, and in general has the same geognostic situation as common calcedony. The secondary trap rocks so abundant in Scotland, often contain carnelian, either alone, or in agate. The most beautiful carnelians, viz. those having an uniform blood-red colour, are found in rolled pieces, and are brought to this country from Arabia, India, Surinam, Siberia, and Sardinia: less beautiful varieties are found in Bohemia, Saxony, and the Palatinate. The fibrous varieties are found in Hungary.

Uses.

It is cut into seal-stones, ring-stones, bracelets, necklaces, brooches, and crosses; and figures are often engraved on it. Artists distinguish three principal kinds of carnelian: the one named *common carnelian*, varies in colour from white, through yellow to red; the second, named *sardé* (sardoine), displays on its surface an agreeable and rich reddish-brown colour, but appears of a deep blood-red colour when held between the eye and the light; the third, named *sardonyx*, is composed of layers of white and red

[Subsp. 12. *Calcedony*,—4th Kind. *Carnelian*.

red carnelian. In the most esteemed carnelians of the east, the colours are of a uniform tint throughout the mass, without any undulations, and are free from that muddiness to which the European varieties of this stone are so liable. The most highly prized varieties are the white and red striped, or sardonyx, and the blood-red; the next in estimation are the pale-red; and the least valuable are the yellow, white, and brown. As it is a softer stone than common calcedony, it is more easily cut, and splinters much less when cutting and polishing; and hence, independent of colour, it has always been preferred by artists to the common calcedony. The finest varieties of carnelian are named by French artists those of the *old rock* (*vieille roche*), because they are no longer to be found so perfect in colour and transparency. The finest pieces of common carnelian are brought from Arabia, and from Cambay and Surat, in India*. The *sardé*, which is very rare at present, and bears a much higher price than the common carnelian, is procured from the shores of the Red Sea. Formerly carnelians used to be imported from Japan into Holland, and from thence were

* The carnelians of Cambay are procured from the neighbourhood of Broach, by sinking pits during the dry season, in the channels of torrents. The nodules which are thus found, are intermixed with other rolled pebbles, and weigh from a few ounces to two or three pounds. Their colour, when recent, is dark olive-green, inclining to grey. The preparation which they undergo, is, first, exposure to the sun for several weeks, and then calcination. The latter process is performed by packing the stones in earthen-pots, and covering them with a layer five or six inches thick of dried goats dung. Fire is then applied to the mass; and in twelve hours, the pots are sufficiently cool to be removed. The stones which they contain are now examined, and are found to be some of them red, and others nearly white; the difference in their respective tints depending in part on the original quality of colouring matter, and in part, perhaps on the difference in the heat to which they have been exposed. The annual value of Carnelian exported from India, amounts to £11,600.

were carried to Oberstein on the Rhine, in order to be exchanged for the agates of that country, which were exported to China.

The carnelian was much esteemed by the ancients. Many fine antique engraved carnelians are preserved in collections; and these have been described by Count Caylus, De Dree, and others. The sardoníyx was cut into cameas, and afforded by far the most beautiful articles of this kind. The finest antique *camea* at present known, is in the French Imperial Museum at Paris: it is cut in a sardoníyx, is of an oval shape, and is eleven inches by nine in breadth: it represents the *Apotheosis of Augustus*.

Observations.

1. It is distinguished from *Commun Calcedony* by its glistening lustre, and conchoidal fracture. The milk-white variety, which approaches to common calcedony, may be distinguished from it, by its conchoidal fracture, and greater transparency.

2. It bears the same relation to Common Calcedony that Conchoidal Hornstone does to Splintery Hornstone.

3. It passes into Hornstone.

4. It was first accurately described by Werner, and united with the sardoníyx of the ancients. Werner divided it into two kinds, Conchoidal and Fibrous.

5. Carnelian is named *sarda* by the ancients, according to some, from the city of Sardis in Lydia, in the vicinity of which this stone was found; according to others, from Sardinia, where it was also found; or according to others, from the Greek word *σαρδός*, which was given to it by reason of its predominating flesh-red colour. Lastly, as already remarked, some derive *carnelian* from the Latin words *caro* or *carneus*, which may have been given to it, owing to its flesh-red colour.

*Thirteenth Subspecies.***Heliotrope *.****Heliotrop, Werner.**

Heliotropium, *Plin.* Hist. Nat. xxxvii. 10. p. 60.—**Jaspis variegata**, *Heliotropius*, *Wall.* t. i. p. 315.—**Heliotrop**, *Wid.* s. 316.—**Heliotropium**, *Kirw.* vol. i. p. 314. *Id.* *Estner*, b. i. s. 589. *Id.* *Emm.* b. i. s. 171.—**Heliotropio**, *Nap.* p. 193.—**Jaspe sanguin**, *Lam.* t. ii. p. 166.—**L'Heliotrope**, *Broch.* t. i. p. 276.—**Quartz-jaspe sanguin**, *Haüy*, t. ii. p. 436.—**Heliotrop**, *Reuss*, b. ii. s. 319. *Id.* *Lud. Suck. Bert.* *Id.* *Mohs*, b. i. s. 309. *Id.* *Karsten*, *Tabel.* *Id.* *Leonhard*, *Tabel.* *Id.* *Hab.*—**Silex Heliotrope**, *Brong.* t. i. p. 297.—**Quartz-jaspe sanguin**, *Lucas*, p. 37. *Id.* *Brard*, p. 101.—**Bloodstone**, *Kid*, vol. i. p. 210.—**Quartz-agathe ponctuée**, *Haüy*, *Tabl.* p. 27.—**Heliotrop**, *Steffens*, b. i. s. 162. *Id.* *Hoff.* b. i. s. 105. *Id.* *Lenz*, b. i. s. 423. *Id.* *Oken*, b. i. s. 271. *Id.* *Haus.* *Handb.* b. ii. s. 407. *Id.* *Aikin*, p. 181.

External Characters.

The principal colour is intermediate between celandine-green and leek-green; sometimes passes into mountain-green, and even into grass and pistachio green. All these colours are dark. Sometimes it is marked with olive-green spots and stripes. The blood and scarlet red and the ochre-yellow dots and spots, are owing to disseminated jasper.

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* The name *Heliotrope* is of Greek extraction, from *ἥλιος*, the sun, and *τροπή*, to turn. According to Pliny, it received this name, because it was used for solar observations.

It occurs massive, in angular pieces and rolled pieces.

The internal lustre is glistening, and resinous.

The fracture is large and flat, but sometimes imperfect conchoidal.

The fragments are angular, and very sharp-edged.

It is generally translucent on the edges; some varieties are translucent.

It is easily frangible.

It is hard; but softer than calcedony.

It is rather heavy.

Specific gravity, 2.623, *Karsten*.—2.700, *Kirwan*.—2.614, *Hoffmann*.—2.633, *Blumenbach*.

Chemical Characters.

It is infusible before the blowpipe.

Constituent Parts.

Silica,	-	84.00
Alumina,	-	7.50
Iron,	- -	5.00

Tromsdorf.

Geognostic Situation.

It is found in rocks belonging to the secondary transformation, and probably occurs in the same kind of repository as calcedony.

Geographic Situation.

The ancients procured this mineral from Æthiopia. At present, the most highly esteemed varieties are brought from Bucharía, Great Tartary, and Siberia. It occurs also in Iceland; and it is said also in Transylvania, Sardinia,

clina, and Bohemia. In Scotland, a variety of mineral nearly resembling heliotrope, occurs in the island of Rume.

Uses.

This mineral was well known to the ancients, who have left us accurate descriptions of it. Figures were seldom cut upon Heliotrope until after the commencement of the Christian era, when representations of religious subjects were often engraved upon it. There is a fine engraved stone of this kind in the National Library in Paris, representing the head of *Christ flagellé*, so cut that the red spots are made to represent drops of blood. It is also cut into seals, snuff-boxes, and other ornamental articles. The varieties having the greatest degree of transparency, and most numerous red spots, are the most highly prized: these are found in Bucharina. The Siberian varieties are destitute of red spots.

Observations.

1. It is distinguished from *Common Calcedony* by its colour, fracture, lustre, and transparency.
2. It is Calcedony, intimately combined with Green Earth.
3. Its fracture and transparency shew that it is a species intermediate between Calcedony and Jasper.

Fourteenth Subspecies.

Jasper *.

THIS subspecies is divided into five kinds, viz. Egyptian Jasper, Striped Jasper, Porcelain-Jasper, Common Jasper, and Agate-Jasper.

First Kind.

Egyptian Jasper.

This kind is subdivided into Red Egyptian Jasper, and Brown Egyptian Jasper.

1. Red Egyptian Jasper.

Rother Egyptischer Jaspis, *Werner*.

Rother Egyptischer Jaspis, *Hoff.* b. ij. s. 162.—Rother Kugel Jaspis, *Steffens*, b. i. s. 181.—Rother Egyptischer Jaspis, *Lenz*, b. i. s. 416.

External Characters.

Its colour is intermediate between flesh-red and blood-red; also ochre-yellow, yellowish-brown, and yellowish-grey. These colours form ring-shaped delineations.

It is found in roundish blunt edged rolled pieces.

The external surface is rough; also uneven and dull.

Internally it is dull, or very faintly glimmering.

The fracture is large, and rather flat conchoidal.

It

* Etymologists are in doubt as to the origin of the word *Jasper*. Some, as Isidorus, derive it from the Greek word *ias*, which signifies green, a frequent colour of this mineral. But whatever may have been its original signification, we know that it is of high antiquity, because it occurs in the Hebrew and Greek languages. We are also ignorant of the particular stone denominated Jasper by the ancients.

[Subsp. 14. *Jasper*,—1st Kind, *Egyptian Jasper*,—2. *Brown Egyptian Jasper*.

It breaks into indeterminate angular and sharp-edged fragments.

It is very feebly translucent on the edges.

It is hard.

It is rather easily frangible.

Specific gravity, 2.632, *Hoffmann*.

Geognostic and Geographic Situations.

It is found imbedded in red clay-ironstone in Baden.

Use.

It is used for ornamental purposes.

Observations.

It sometimes passes into Flint, but is distinguished from that mineral by its opacity, and inferior hardness.

2. Brown Egyptian Jasper.

Brauner Egyptischer Jaspis, *Werner*.

Silex Aegyptiacus, *Wall.* t. i. p. 276.—Egyptian Pebble, *Kirw.* vol. i. p. 312.—Egyptischer Jaspis, *Emm.* b. i. s. 234.—Cail-lou d'*Egypte*, *La Meth.* t. ii. p. 166.—Le Jaspe Egyptien, *Broch.* t. i. p. 332.—Egyptischer Jaspis, *Reuss*, b. ii. s. 302. *Id.* *Lud.* b. i. s. 93. *Id.* *Suck.* 1st th. s. 353. *Id.* *Bert.* s. 227. *Id.* *Mohs*, b. i. s. 314. *Id.* *Leonhard*, Tabel. s. 11.—Jaspe Egyptien, *Brong.* t. i. p. 325.—Egyptischer Jaspis, *Karst.* Tabel. s. 38.—Egyptian Jasper, *Kid*, vol. i. p. 208.—Quartz-agathe opaque, *Haidy*, Tabl. p. 27.—Brauner Kugel Jaspis, *Steffens*, b. i. s. 180.—Brauner egyptischer Jaspis, *Hoff.* b. ii. s. 164. *Id.* *Lenz*, b. i. s. 414.—Egyptian Jasper, *Aikin*, p. 183.

External

External Characters.

Its colours are chesnut-brown, yellowish-brown, isabella-yellow, and yellowish-grey. The yellowish-grey, or isabella-yellow, generally form the interior or centre of the pebble; and the brown colours are disposed in concentric stripes, alternating with black stripes. In the brown colour, there sometimes occur black spots, and similar coloured dendritic delineations.

It occurs in roundish, blunt edged, and spheroidal masses.

The surface is uneven or rough.

Externally it is glimmering, very seldom feebly glistening; internally it is partly glistening, partly glimmering; but the grey is dull.

The fracture is flat and perfect conchoidal.

The fragments are indeterminate angular and sharp-edged.

It is very feebly translucent on the edges, or almost opaque.

It is as hard as hornstone.

Specific gravity, 2.564, *Brisson*.—2.601, 2.624, *Hoffmann*.

Chemical Character.

It is infusible without addition before the blowpipe.

Geognostic Situation.

The geognostic situation of this mineral is still imperfectly known. Cordier informs us, that it is found imbedded in a conglomerate rock, which, in his opinion, extends in great beds throughout Egypt to the deserts of Africa; while

[Subsp. 14. *Jasper*,—2d Kind, *Striped Jasper*.

while Mohs, from the resemblance of its colour-delineations to those of agate, supposes that it has been formed by infiltration, in the manner of agate, and therefore, that Egyptian jasper will be found to occur in amygdaloid. In whatever original situation it occurs, it is well known, from the observations of travellers, to occur loose in the sands of Egypt.

Geographic Situation.

It has been hitherto found only in Egypt.

Uses.

As the colours of this mineral are agreeable to the eye, beautifully disposed, and as it receives a good polish, it is prized by jewellers as an ornamental stone, and is cut into various ornamental articles.

Observations.

Colour, colour-delineation, external shape, and low degree of lustre, are the most distinguishing characters of this mineral.

Second Kind.

Striped Jasper.

Band Jaspis, *Werner*.

Striped Jasper, *Kirw.* vol. i. p. 312.—Band Jaspis, *Emm.* b. i. s. 237.—Jaspe rubane, *Lam.* p. 165.—Le Jaspe rubane, *Broch.* t. i. p. 334.—Band Jaspis, *Reuss*, b. ii. s. 305. *Id. Lud.* b. i. a. 94. *Id. Suck.* 1^r th. s. 355. *Id. Bert.* s. 228. *Id. Mohs*, b. i.

b. i. s. 116. *Id. Hab.* s. 13, *Id. Leenhard*, Tabel. s. 11.—
 —Jaspe Rubanne, *Brong.* t. i. p. 324.—Band Jaspis, *Karsten*,
 Tabel. s. 38.—Riband Jasper, *Kid*, vol. i. p. 207.—Quartz-
 jaspe Onyx, *Haüy*, Tabl. p. 28.—Band Jaspis, *Steffens*, b. i.
 s. 182. *Id. Hoff.* b. ii. s. 166. *Id. Lenz*, b. i. s. 417. *Id. Oken*,
 b. i. s. 298.—Striped Jasper, *Aikin*, p. 44.

External Characters.

Its colours are grey, green, yellow, and red, and seldom blue. Of grey, it presents the following varieties, pearl-grey, greenish-grey, and yellowish-grey : Of yellow, cream-yellow, which passes into straw-yellow : Of green, mountain-green, which passes into leek-green and greenish-grey : Of red, cherry-red, brownish-red, and flesh-red ; the cherry-red passes into plum-blue.

There are always several colours together, and these are arranged in striped and flamed, and sometimes in spotted delineations.

It occurs massive, in whole beds.

Internally it is dull, when an admixture of foreign ingredients does not give it a feeble glimmering lustre.

The fracture is large and flat conchoidal, which approaches sometimes to fine earthy, sometimes to even. In the large it sometimes inclines to slaty, and the laminæ are in the direction of the striped delineations.

The fragments are indeterminate angular, and rather sharp-edged.

It is opaque, or very feebly translucent on the edges.

It is hard, but rather in a lower degree than the Egyptian jasper.

It is rather easily frangible.

Specific

Specific gravity, 2.441, *Haberle*.—2.472, 2.537, 2.553, *Hoffmann*.—2.491, *Karsten*.

Geognostic and Geographic Situations.

It occurs in secondary clay-porphry in the Pentland Hills near Edinburgh; in a similar situation at Gnadenstein and Wolfütz, near Froburg in Saxony. In neither of these countries do we observe the leek-green and brownish-red striped varieties: these latter occur only in the beautiful striped jasper which is found at Orsk, in the district of Orenburg in Siberia. According to Hausmann, it occurs in the Hartz, along with common flinty-slate and Lydian stone, in clay-slate mountains.

Use.

This mineral receives an excellent polish, and hence is used like agate for ornamental purposes.

Observations.

1. The distinguishing characters of this mineral, are its colour-delineations, its want of lustre, and its very flat conchoidal fracture, which sometimes inclines to earthy, and even to slaty. Its geognostic situation also distinguishes it from all the other subspecies of this species.

2. It is allied to Conchoidal Hornstone and Claystone, and passes into both of these minerals. These transitions are to be observed in the Pentland Hills. It is distinguished from *Conchoidal Hornstone* by its colour, colour-delineations, want of lustre, its more perfect flat conchoidal fracture, and its opacity: from *Claystone* it is distinguished by its greater hardness.

Third Kind.

Porcelain-Jasper.

Porzellan Jaspis, *Werner*.

Id. Wid. p. 314.—Porcellanite, *Kirn.* vol. i. p. 313.—Porzellan-Jaspis, *Estner*, b. ii. s. 613. *Id. Emm.* b. i. s. 240.—Diaspro porcellanico, *Nap.* p. 192.—Jaspe porcelaine, *Lam.* t. ii. p. 166. *Id. Broch.* t. i. p. 166.—Thermantide porcellanite, *Häuy*, t. iv. p. 510.—Porzellan Jaspis, *Reuss*, b. ii. s. 307. *Id. Lud.* b. i. s. 94. *Id. Suck.* 1^r th. s. 351. *Id. Bert.* s. 226. *Id. Mohs*, b. i. s. 321. *Id. Karsten*, Tabel. s. 38. *Id. Leonhard*, s. 12. *Id. Steffens*, b. i. s. 184. *Id. Hoff.* b. ii. s. 168. *Id. Lenz*, b. i. s. 418. *Id. Oken*, b. i. s. 298. *Id. Haus.* b. ii. s. 398.—Porcellanite, *Aikin*, p. 241.

External Characters.

Its colours are grey, blue, yellow, and seldom black and red. Of grey, it presents the following varieties; smoke, bluish, yellowish, and pearl grey: from pearl-grey it passes into lilac-blue and lavender-blue: also into brick-red, which inclines to yellow: from yellowish-grey it passes into straw-yellow, and ochre-yellow: from smoke-grey into greyish-black, and ash-grey.

It generally exhibits but one colour, and is sometimes marked with dotted, flamed, striped, and clouded delineations.

The grey varieties are generally brick-red in the rifts. It often presents brick-red vegetable impressions; and this is most frequently the case with the lavender-blue varieties.

It occurs most commonly massive, and in angular pieces; and is frequently cracked in all directions.

Internally

Internally it is glistening, sometimes approaching to shining, sometimes to glimmering, and even to dull; and the lustre is vitreo-resinous.

The fracture is imperfect conchoidal, and sometimes large and flat, and occasionally small conchoidal.

The fragments are indeterminate angular and sharp-edged.

It is opaque.

It is hard in a low degree.

It is easily frangible.

Specific gravity, 2.330, *Kirwan*.—2.430, *Karsten*.—2.431, 2.432, 2.461, 2.577, 2.595, 2.645, *Hoffmann*.

Chemical Characters.

The lavender-blue variety, when exposed to a heat of 151° of Wedgwood, according to *Kirwan*, melts into a spongy yellowish-grey semi-transparent mass. Other varieties, according to *Link*, melt before the blowpipe into a white glass.

Constituent Parts.

Silica,	-	60.75
Alumina,	-	27.25
Magnesia,	-	3.00
Oxide of Iron,	-	2.50
Potash,	-	3.66

According to *Rose*.

Geognostic Situation.

It is always found along with burnt-clay and earth-slugs, in places where pseudo-volcanoes have formerly burnt, or where

where beds of coal are now in a state of inflammation. Hence it follows, that it is a pseudo-volcanic production; and, according to Werner, it is slate-clay converted into a kind of porcelain by the action of the heat of the volcano. As the coal wastes, hollows are formed in the bed, and the superincumbent porcelain-jasper breaks in pieces, and falls into them: hence it never occurs in regular beds, but in irregular broken masses, intermixed with burnt-clay, earth-slugs, and similar substances.

Geognostic Situations.

It is found on the coast of Fifeshire; at Madeley, in Shropshire; and near Dudley in Warwickshire. It occurs in Bohemia, principally in the plain betwixt the Erzgebirge and the Mittelgebirge, where immense beds of coal appear. It also appears at Planitz, near Zwickau in Saxony, and in the neighbourhood of Zittau in Upper Lusatia. Likewise at Erterode, at the Meisner, in the Habichtswald; at Dutweiler, in the department of Saare; and also in Iceland.

Fourth Kind.

Common Jasper.

Gemeiner Jaspis, *Werner*.

Jaspis, *Cronst.* § 64, 65. p. 76.—Jaspis, *Wall.* p. 311. & 318.—Gemeiner Jaspis, *Wid.* s. 311.—Common Jasper, *Kirr.* vol. i. p. 310.—Gemeiner Jaspis, *Emm.* b. ii. s. 243.—Diaspro commune, *Nap.* p. 189.—Jaspe, *Lam.* p. 164.—Le Jaspe commune, *Broch.* t. i. p. 338.—Quarz-jaspe, *Hayy,* t. ii. p. 435.—Gemeiner Jaspis, *Reuss,* b. ii. s. 311. *Id. Lud.* b. i. s. 95.
Id.

[Subsp. 14. *Jasper*,—4th Kind, Common *Jasper*.

Id. Suck. 1r th. s. 348. *Id. Bert.* s. 228. *Id. Mohs*, b. i. s. 317. *Id. Hab.* s. 11.—Quartz-jaspe, *Lucas*, p. 37.—Jaspe commun, *Brong.* t. i. p. 324.—Quartz-jaspe, *Brard*, p. 101.—Gemeiner Jaspis, *Leonhard*, Tabel. s. 12. *Id. Karst.* Tabel. s. 38.—Jasper, *Kid*, vol. i. p. 206.—Quarz-jaspe, *Haüy*, Tabl. p. 28.—Gemeiner Jaspis, *Steffens*, b. i. s. 185. *Id. Hoff.* b. ii. s. 172. *Id. Lenz*, b. i. s. 420. *Id. Oken*, b. i. s. 298.

External Characters.

The most common colours are red and brown; seldom yellow and black. It occurs brownish-red, cherry-red, blood-red, cochineal-red, scarlet-red, ochre-yellow, yellowish-brown, chesnut-brown, liver-brown, blackish-brown, and pitch-black.

It has generally only one colour; sometimes, however, it occurs with spotted, clouded, flamed, or striped delineations.

It occurs generally massive, sometimes also disseminated, in blunt-cornered, rolled pieces, mixed with calcedony in a moss-like manner, and rarely reticulated.

Internally it varies, according to the fracture, from shining to dull; and the lustre is resino-vitreous.

The fracture of some varieties is more or less perfect and flat conchoidal, and these have a shining or glistening lustre: in others it is even, with a glimmering lustre, or fine earthy and dull.

The fragments are indeterminate angular, and more or less sharp-edged.

It is opaque, or very faintly translucent on the edges.

It is hard in a low degree.

It is rather easily frangible.

Specific gravity, 2.554, 2.671, *Haberle*.—2.580, 2.700, *Kirwan*.—2.298, 2.314, 2.349, 2.573, 2.665, *Hoffmann*.

Chemical

Chemical Characters.

It is infusible without addition before the blowpipe.

It retains its colour for a considerable time, and at length becomes white.

Geognostic Situation.

It occurs principally in veins, as a constituent part of agates, or in imbedded cotemporaneous masses in primitive, transition, and secondary rocks. The veins in which it occurs are either entirely filled with jasper, or they contain also ores of different kinds, as of iron, lead, or silver. It is found more abundantly in ironstone veins than in those of lead and silver; and the iron ores with which it is associated, are red and brown ironstone, accompanied with quartz and iron-flint. The lead ores are lead-glance; and the argentiferous minerals are native silver, and vitreous silver-ore. The most beautiful varieties, and the largest masses, occur in veins entirely filled with jasper, or a mixture of jasper and agate.

Geographic Situation.

Europe.—It occurs in the Pentland Hills, and Moorfoot Hills, near Edinburgh; and in different places along the course of the rivers Tweed and Clyde, where it is contained in clay-slate and greywacke rocks. It occurs in trap rocks and transition rocks in Ayrshire and Dumfriesshire. To the north of the Frith of Forth it is not unfrequent, both in the form of veins and imbedded portions. In the fine display of rocks described by Colonel Imrie, as occurring in the course of the North Esk river in the Mearns, there are cotemporaneous masses and veins of jasper in transition rocks. It occurs also in the Shetland Islands,
and

[*Subsp. 14. Jasper,---4th Kind, Common Jasper.*

and in several of the Hebrides. On the Continent of Europe it has been observed in Sweden, Russia, Germany, Hungary, Transylvania, France, Italy, Spain, Portugal; and in the islands of the Mediterranean, particularly Sicily.

Asia.—It is found in great abundance in Siberia.

Uses.

When it occurs in sufficiently large masses, and receives a good polish, it is cut into various ornamental articles, as vases, snuff-boxes, ringstones, &c. The finest varieties are used for engraving on: many beautiful antique engraved stones of common jasper are preserved in collections.

Observations.

1. Colour, lustre, fracture, and geognostic situation combined, distinguish this kind of jasper from the others.
2. It passes into Iron-flint and into Clay-Ironstone, and is nearly allied to Hornstone and Claystone.
3. The *Sinopel* of some mineralogists is a variety of common jasper.

Fifth Kind.

Agate Jasper.

Agat-Jaspis, *Werner.*

Id. Broch. t. ii. p. 141.—*Agath-Jaspis, Reuss,* b. ii. s. 316. *Id. Lud.* b. i. s. 95. *Id. Mohs,* b. i. s. 322. *Id. Leonhard,* Tabel. s. 12. *Id. Karsten,* Tabel. s. 38. *Id. Steffens,* b. i. s. 187. *Id. Hoff.* b. ii. s. 175. *Id. Lenz,* b. i. s. 422. *Id. Oken,* b. i. s. 298.

External

External Characters.

Its colours are yellowish-white and reddish-white; the yellowish-white passes into cream and straw yellow, and approaches to ochre-yellow; the reddish-white passes into flesh-red and pale blood-red. Several colours generally occur together, and these are arranged either in clouded, flamed, or striped delineations; of these the striped are either disposed in a circular manner, or fortification-wise.

It occurs massive.

It frequently occurs in distinct concretions, which are either fortification-wise bent, or concentric lamellar.

Internally it is dull.

The fracture is small and flat conchoidal, approaching to even.

The fragments are indeterminate angular, and rather sharp-edged.

It is generally opaque, or slightly translucent on the edges.

It is hard in a low degree.

It sometimes adheres slightly to the tongue.

Chemical Character.

Before the blowpipe it is affected in the same manner as common jasper.

Geognostic Situation.

It occurs principally in layers, in agate-balls, in amygdaloid; likewise in agate balls and veins in porphyry.

Geographic Situation.

It occurs in the agates of the middle district of Scotland,
in

in Mid Lothian, West Lothian, and East Lothian; also in Saxony, Deuxponts, and Hungary.

Observations.

It is distinguished from the other kinds of Jasper, by its colour-delineations, fracture, hardness, weight, and geognostic situation.

Agate *.

AGATE is not, as some mineralogists maintain, a simple mineral, but is composed of various species of the quartz family, intimately joined together, and the whole mass is so compact and hard, that it receives a high polish. From its compound nature, it ought rather to be considered in the geognostic part of this work; yet as Werner and other mineralogists describe it along with the quartz genus, we shall not deviate from their plan.

Agate is principally composed of calcedony, with flint, hornstone, carnelian, jasper, cacholong, amethyst, and quartz. Of these minerals sometimes only two, in other instances more than three occur in the same agate; and these are either massive, disseminated, or in layers. Agates are by Werner divided into different kinds, according to their colour-delineations; and he enumerates the following:—
 1. *Ribbon or Striped Agate.* 2. *Brecciated Agate.* 3. *Fortification-Agate.* 4. *Tubular Agate.* 5. *Landscape-Agate.* 6. *Moss-Agate.* 7. *Jasper-Agate.*

* The name *Agate*, is derived from the river Achates in Sicily, where it is said this mineral was first found.

1. *Ribbon or Striped Agate.*

It is composed of layers of calcedony, flint, and amethyst, and also of hornstone, jasper, and quartz, which alternate with each other, vary in breadth, and although sometimes curved, sometimes straight, yet are always parallel. When this agate is cut at right angles to the layers, the *common striped agate* is formed: when the section is made across a reniform elevation, we obtain the *zoned agate*; and when the section is oblique, the *serpentine agate* is formed.

This agate occurs principally in veins. A magnificent vein of this kind occurs at Cunnersdorf and Schlottwitz in Saxony, and another at the Halsbach, near Freyberg, and both are situated in gneiss. Agate veins of this kind occur also in porphyry, and these are of great size, as at Wiederau, near Rochlitz in Saxony; or in numerous small veins, traversing the porphyry in all directions, as at Rothlof, near Chemnitz, also in Saxony.

2. *Brecciated Agate.*

This beautiful agate is composed of fragments of another species, which is usually striped agate, generally connected together by a basis of amethyst. This agate occurs in the middle of the great vein of striped agate at Cunnersdorf.

According to some mineralogists, Ribbon-agate is supposed to have been formed from different solutions which have been successively decomposed in a previously existing rent or fissure. The brecciated agate, which is found in the middle of the vein of ribbon-agate, is conjectured to have owed its origin to a rent or rents taking place in that agate; and the fragments thus formed being afterwards connected together, by a new solution poured into the fissure or fissures. This opinion, however plausible, is certainly liable to numerous objections.

3. *Fortification-*

3. *Fortification-Agate.*

This agate is composed of layers of calcedony, flint, and jasper, which have generally in the middle a nucleus of massive amethyst. These layers are thin and parallel, and are fortification-wise bent. It generally occurs in irregular balls, which are contained in amygdaloid. When these balls are cut across, their surface sometimes very much resembles a fortification. The largest agates of this description occur at Oberstein on the Rhine; - and many beautiful varieties are met with in the amygdaloid rocks which abound so much in Scotland.

4. *Tubular-Agate.*

When the central spaces in stalactitic calcedony are filled with agate, the compound is named Tubular Agate. It is a rare variety.

5. *Landscape-Agate.*

In this the substances are so arranged, that the whole may be likened to a landscape. It also is a rare variety.

6. *Moss-Agate.*

In this beautiful kind of agate, jasper of various colours, as brown, yellow, and red, appears as it were floating in a basis of calcedony. The jasper resembles moss, and when its arborizations are distinct, it has a very beautiful appearance. All the parts here are evidently of cotemporaneous formation.

7. *Jasper-Agate.*

Jasper-agate is a mixture of calcedony, or hornstone, and jasper. The jasper is of a red, yellow, or brown colour,

and is the predominating ingredient in the agate. It occurs in veins, which sometimes contain ores of different kinds, as ores of silver and iron.

The following are less important kinds of agate.

1. *Spotted-Agate.*

In this beautiful agate, spots of red, yellow, or brown jasper, are dispersed through a calcedonic base. The St Stephen stone, already described under the article Calcedony, may be considered as a spotted agate.

2. *Clouded-Agate.*

It is so named from its clouded appearance: the clouded delineations are of jasper.

3. *Star-Agate.*

This is an agate with stellular markings.

4. *Petrifaction-Agate.*

This agate contains petrifications of marine animal substances, as shells of the turbinites and tubulites tribes.

Geognostic Situation.

Agates, as already mentioned, occur in veins in gneiss, and in porphyry, and in balls in amygdaloid, greenstone, and porphyry; and probably these, as well as all the other repositories of this singular compound mineral, are of contemporaneous formation with the rocks in which they are contained.

Geographic Situation.

Very beautiful varieties of the different kinds of agate occur in the porphyry, amygdaloid, and greenstone rocks of Scotland.

Scotland. On the Continent there is a great depository of agate at Oberstein on the Rhine: it also occurs in Saxony, Silesia, Bohemia, and Italy; also in the island of Sicily. It likewise abounds in Siberia, East Indies, and China.

Uses.

Agate is sometimes cut into snuff-boxes, and ring-stones: the larger masses are hollowed into mortars, or cut into elegant vases. It was much prized by the ancients, who executed several fine works in it. In the Electoral Cabinet at Dresden, and the Ducal Cabinet in Brunswick, there are beautiful vases of agate. At Oberstein on the Rhine, the amygdaloid rocks are regularly quarried for the agates they contain, and these are cut and polished, and exported to other countries. The cutting, polishing, and selling of the agates (Scotch) of the amygdaloid of this country, is now carried on to a very considerable extent, and is to many a lucrative employment.

TABULAR

TABULAR VIEW
OF THE
PELLUCID GEMS,

*Arranged according to Colour, with some of their more
 Distinctive Characters *.*

	Spec. Grav.	Hardness.	Refraction.
I. WHITE and GREY GEMS.			
a. Diamond,	3.5	Scratches all other minerals.	Simple.
b. Sapphire,	4.0	Scratches topaz.	Feeble double refraction.
c. Topaz of Brazil,	3.55	Scratches rock-crystal.	Double refraction, stronger than sapphire.
d. Rock-crystal,	2.65	Scratches felspar.	Same as the preceding.
II. RED GEMS.			
a. Oriental ruby,	4.2	Scratches topaz.	Feeble double refraction.
b. Spinel ruby,	3.7	Scratches topaz, but in a lower degree than oriental ruby.	Simple.

* This Table is in imitation of that given by Haüy, in his Treatise on Gems.

	Spec. Grav.	Hardness.	Refraction.
c. Brazilian ruby, or red topaz,	3.5	Scratches rock-crystal, but does not affect spinel.	Double in a moderate degree.
d. Precious garnet, columbine-red colour.	4.0	Scratches rock-crystal in a moderate degree.	Simple.
e. Pyrope, blood-red colour,	3.7	Scratches rock-crystal more readily than precious garnet.	Simple.
f. Tourmaline,	3.0	Scratches rock-crystal but feebly.	Double in a moderate degree.
<p>III. BLUE GEMS.</p>			
a. Oriental sapphire,	4.2	Scratches topaz.	Feeble double refraction.
b. Beryl, or Aquamarine,	2.7	Scratches rock-crystal feebly, but not topaz.	Feeble double refraction.
c. North American tourmaline,	3.0	Scratches rock-crystal feebly.	Double refraction.
d. Water Sapphire or Dichroite. When viewed in one direction, violet-blue, in another brownish-yellow.	2.7	Same as preceding.	Feeble double refraction.
<p>IV. GREEN GEMS.</p>			
a. Oriental emerald or green Sapphire,	4.2	Scratches topaz, and spinel ruby.	Feeble double refraction.
b. Peruvian emerald, or true emerald,	2.8	Scratches rock-crystal, but not topaz.	Feeble double refraction.

	Spec. Grav.	Hardness.	Refraction.
c. Brazilian or Columbian emerald, a variety of tourmaline.	3.0	Scratches rock-crystal feebly.	Double refraction.
d. Chrysoprase,	2.6	Scratches glass and felspar.	
V. BLUISH-GREEN GEMS.			
a. Oriental aquamarine, a variety of sapphire,	4.0	Scratches topaz.	Feeble double refraction.
b. Siberian beryl,	2.6	Scratches rock-crystal.	Feeble double refraction.
VI. YELLOW GEMS.			
a. Oriental topaz, a variety of sapphire,	4.	Scratches topaz.	Feeble double refraction.
b. Brazilian topaz,	3.5	Scratches rock-crystal, but not so deeply as spinel.	Feeble double refraction.
c. Yellow zircon or jargoon,	4.4	Scratches rock-crystal, but not topaz.	Strong double refraction.
VII. YELLOWISH GREEN and GREENISH-YELLOW GEMS.			
a. Oriental peridot, a variety of sapphire,	4.	Scratches topaz.	Feeble double refraction.

	Spec. Grav.	Hardness.	Refraction.
b. Chrysoberyl, or Oriental chrysolite,	3.8	Nearly as hard as sapphire.	Refracts double in a middling degree.
c. Beryl, or aqua-marine,	2.6	Scratches quartz but feebly.	Feeble double refraction.
d. Jargoon of Ceylon, or yellowish-green zircon,	4.4	Scratches rock-crystal more easily than beryl.	Very perfect double refraction.
e. Chrysolite,	3.4	Scratches felspar, but not rock-crystal.	Refracts double in a high degree, but not so powerfully as zircon.
f. Yellowish-green tourmaline, or peridot of Ceylon,	3.0	Scratches rock-crystal feebly.	Double refraction.
VIII. VIOLET GEMS.			
a. Oriental amethyst, a variety of sapphire,	4.0	Scratches topaz.	Feeble double refraction.
b. Amethyst,	2.7	Scratches felspar.	Refracts double in a middling degree.
IX. HYACINTH-RED GEMS.			
a. Cinnamon stone,	3.6	Scratches rock-crystal feebly.	Simple.
b. Hyacinth-garnet, or vermeille,	4.0	Scratches rock-crystal in a middling degree.	Simple.

	Spec. Grav.	Hardness.	Refraction.
c. Hyacinth,	4.4	Scratches rock-crystal in a middling degree.	Perfect double refraction.
d. Hyacinthine tourmaline.	3.0	Scratches rock-crystal feebly.	Double refraction.
<p>X. GEMS which are OPALESCENT, or display a fine play of colour.</p>			
a. Asterias, or star-stone, a variety of sapphire.	4.0	Scratches topaz.	
1. Ruby asterias, red ground.			
2. Sapphire asterias, blue ground.			
3. Topaz asterias, yellow ground.	3.5	Scratches rock-crystal.	
b. Opal, *	2.1	Scratches white glass feebly,	
c. Oriental girasol, or girasol corundum, with a milky ground, from which there shoot bluish and yellowish pencils of light,	4.0	Scratches topaz,	
d. Moonstone, argentine, or fish-eye stone, is a variety of felspar,	2.6	Scratches felspar, but not rock-crystal.	
e. Sunstone, or Oriental aventurine,	2.6		
f. Labrador-stone,	3.0		

* The three last-mentioned minerals belong to the order of Spar, and are placed here merely on account of their opalescent properties.

2. Indivisible Quartz.

Untheilbares Quartz, *Mohs*.

This species contains nine subspecies, viz. 1. Float-stone, 2. Quartzzy Sinter, 3. Hyalite, 4. Opal, 5. Menilite, 6. Obsidian, 7. Pitchstone, 8. Pearlstone, 9. Pumice-stone.

First Subspecies.

Float-stone, or Spongiform Quartz.

Schwimmstein, *Werner*.Quartz nectique, *Haüy*.

Schwimmstein, *Hoff.* b. ii. s. 75.—Schwimkiesel, *Haus.* Handb. b. ii. s. 416.—Spongiform Quartz, *Aikin*, p. 177.

External Characters.

Its colours are yellowish white, yellowish-grey, and sometimes reddish-white.

It occurs in porous, massive, and tuberoso forms.

Internally it is dull.

The fracture is coarse earthy.

Its fragments are indeterminate angular, and blunt-edged.

It is feebly translucent on the edges.

It is soft, but its particles are as hard as quartz.

It is rather brittle.

It is easily frangible.

It feels meagre and rough, and emits a grating noise when we draw our finger across it.

Specific gravity 0.448, *Karsten*.—0.512, *Tralles*.

Constituent

Constituent Parts.

Silica,	-	91.0	94.0	98.0
Water,	-	6.0	5.0	
Ferruginous alumina,		0.25	0.5	
Carbonate of Lime,		2.00		2.0
Trace of Magnesia.				
		<hr/> 99.25	<hr/> 99.5	<hr/> 100

Bucholz in Leonhard's *Tasch. b. vi.* *Vauquelin.*
s. 5. 8.

Geognostic and Geographic Situations.

It occurs incrusting flint, or in imbedded masses in a secondary limestone, at St Ouen, near Paris. It is said to occur also in the Lausberg, near Achen, and in Pary's mine, Anglesey.

Observations.

This mineral is characterised by colour, tuberosc external shape, porous internal structure, dull, earthy fracture, slight translucency, softness, and specific gravity.

*Second Subspecies.***Quartzzy or Siliceous Sinter.****Kieselsinter, *Werner.***

This subspecies is divided into three kinds, viz. Common Sinter, Opaline Sinter, and Pearly Sinter.

First

First Kind.

Common Quartzy or Siliceous Sinter.

Gemjner Kieselsinter, *Karsten*.

Kiesel-sinter, *Klaproth & Karsten*, *Beit. b. ii. s. 109. Id. Reuss*, b. ii. s. 241. & 245.—Kieseltuff, *Mohs*, b. i. s. 245. *Id. Leonhard*, *Tabel. s. 8.*—Gemeiner Kieselsinter, *Karsten*, *Tabel. s. 24.*—Quartz-agathe concretionné thermogene, *Häuy*, *Tabl. p. 27.*—Quartz-hyaline concretionné, *Brong. t. i. p. 274.*—Gemeiner Kieselsinter, *Steffens*, b. i. s. 128. *Id. Lenz*, b. i. s. 360. *Id. Haus. Handb. b. ii. s. 391.*

External Characters.

Its colours are greyish-white and reddish-white, with light-red and hair-brown spots and stripes; also smoke-grey and yellowish-grey.

It occurs massive, stalactitic, coralloidal, fine fruticose, fine botryoidal, porous; and occasionally contains stems of plants.

It occurs in distinct concretions, which are fine granular, fibrous, and thin and curved lamellar.

Externally it is dull; internally, when it is porous, dull, in other forms glistening and pearly.

The fracture is flat-conchoidal, also coarse-grained uneven.

The fragments are indeterminate angular, and rather blunt-edged.

It is more or less translucent on the edges.

It is semihard.

It is very brittle.

Specific gravity, 1.807, *Klaproth*.—1.816, *Karsten*.

Chemical Characters.

It is infusible without addition before the blowpipe.

Constituent Parts.

Silica,	-	98.0
Alumina,	-	1.5
Iron,	-	0.5
		<hr/>
		100

Klaproth, Beit. b. ii. s. 109.

Geognostic and Geographic Situations.

It occurs abundantly around the hot springs in Iceland. It is deposited from the water of these springs, in which it appears to have been held in a state of solution, partly by the alkali the water contains, partly by its high temperature, which is 212° at the surface, but may be greater in the interior of the earth, where the water appears to be subjected to a considerable degree of compression.

*Second Kind.***Opaline Siliceous Sinter.**

Opalartiger Kieselsinter, *Hausmann*.

Opalartiger Kieselsinter, *Weber's Naturkunde*, b. ii. s. 111.

Id. Steffens, b. i. s. 130.

External Characters.

Its colours are yellowish-white and milk-white, with brownish, blackish, or bluish spots; and on the fracture-surface veined and dendritic delineations.

It

[Subsp. 2. *Quartz* or *Siliceous Sinter*,—2d Kind, *Opaline Siliceous Sinter*.

It is massive.

The fracture is imperfect conchoidal, sometimes passing into even.

Sometimes it occurs in distinct concretions, which are lamellar or granular.

The lustre is glistening.

The fragments are angular and sharp-edged.

It is translucent on the edges.

It is semihard; brittle.

Easily frangible.

Adheres to the tongue.

Chemical Characters and Constituent Parts.

The same as in the first subspecies.

Geographic Situation.

It occurs at the Hot Springs in Iceland.

Observations.

It bears a striking resemblance to Opal.

Third Kind.

Pearl-Sinter, or Fiorite.

Fiorite, Thomson.

Id. Santi, Viaggio al Montaniata, 1795, breve notizia di un viaggiatore sulle incrostazioni silicee ternale d'Italia, &c. 1794.

Id.

Id. Thompson, Bibl. Britan. t. i. Janv. 1790.—Quartz-hyalin concretionné, *Haüy*, t. ii. p. 416.—Perlsinter, *Mohs*, b. i. s. 247. Quartz-hyalin concretionné, *Brong.* t. i. p. 274. *Id. Lucas*, p. 32. *Id. Brard*, p. 92. *Id. Haüy*, Tabl. p. 25.—Perlsinter, *Steffens*, b. i. s. 131. *Id. Lenz*, b. i. s. 361. *Id. Oken*, b. i. s. 278.

External Characters.

Its colours are milk-white, yellowish-white, greyish-white; also pearl-grey and yellowish-grey.

It occurs coralloidal, stalactitic, tubular, cylindrical, fruticose, botryoidal, reniform, and small globular.

Externally it is sometimes smooth and shining, with a pearly lustre, sometimes rough and dull: internally it is dull, glistening, or shining, with a lustre intermediate between resinous and pearly.

It occurs in thin concentric lamellar distinct concretions, which are curved in the direction of the external surface, and incrust massive pearl-sinter, which is in round granular distinct concretions.

The fracture is fine grained uneven; also flat conchoidal, and fine splintery.

The fragments are angular, and not particularly sharp-edged.

It is translucent, often only translucent on the edges; and sometimes is semi-transparent in thin pieces.

It scratches glass, but is not so hard as quartz.

It is brittle, and easily frangible.

Specific gravity 1.917, *Santi*.

Chemical Characters.

It is infusible before the blowpipe without addition.

Constituent

Constituent Parts.

Silica,	-	-	94
Alumina,	-	-	2
Lime,	-	-	4
			<hr/>
			100
			<i>Santi.</i>

Geognostic and Geographic Situations.

It was discovered by Santi, on Montamiata*, and has been found on volcanic tuff and pumice in the Vicentine, at Solfatara, in Ischia, and at St Michael†.

Observations.

According to Dr Thompson it is a volcanic production. The silica, he supposes, was held in solution by means of soda, aided by the high temperature of the vapours which exhale from the bosom of the earth in volcanic countries by natural apertures, named *fumarioli*.

VOL. I.

T

Third

* In the second edition of this work, I mentioned Dr Thompson as the discoverer of Pearl-sinter; but I am told that it was first noticed by Santi, an Italian naturalist.

† Hentland.

*Third Subspecies.***Hyalite.***Hyalith, Werner.*

Hyalite, Kirm. vol. i. p. 296. *Id. Broch.* t. i. p. 272. *Id. Reuss,* b. ii. s. 246.—Quartz concretionné, *Haüy*, Tabl. p. 25.—*Hyalith, Steffens,* b. i. s. 132. *Id. Hoff.* b. ii. s. 131. *Id. Lenz,* b. i. s. 365. *Id. Oken,* b. i. s. 273.—Glasopal, *Haus. Handb.* b. ii. s. 424.—*Hyalite, Aikin,* p. 178.

External Characters.

Its colours are yellowish and greyish white; also yellowish-grey and light ash-grey, and mountain-green*.

It is generally small reniform, small botryoidal, and sometimes stalactitic, and in crusts.

Externally it is smooth and shining; internally it is shining, and splendid; and the lustre vitreous, slightly inclining to resinous.

The fracture is small, and rather flat conchoidal.

The fragments are indeterminate angular and sharp-edged.

It is translucent, approaching to semitransparent.

It is intermediate between hard and semihard.

Specific gravity, 2.476, *Karsten*.—2.140, *Kopp*.

Chemical Characters.

It is infusible before the blowpipe without addition.

Constituent

* This variety is found at Chemnitz in Hungary.

Constituent Parts.

Silica,	-	-	.92.0
Water,	-	-	6.33
Trace of Alumina.			
			<hr/>
			98.33
			<i>Bucholz.</i>

Geognostic and Geographic Situation.

It has been hitherto found principally near Frankfort on the Mayne, where it occurs in fissures in vesicular basalt and basaltic greenstone; it also occurs at Chemnitz in Hungary.

Uses.

It is sometimes cut into ringstones, which externally are not unlike those of Topaz, but are easily distinguished from that mineral, partly by inferior hardness, partly by the delicate rents observable in its interior.

Observations.

1. It is distinguished from *Calcedony* by its colour-suite, its small reniform and botryoidal shapes, its lustre, conchoidal fracture, transparency, and inferior hardness: it is more nearly allied to *Opal*, but is distinguished from it by external aspect, greater transparency and hardness.

2. It is nearly allied to Pearl-Sinter.

Fourth Subspecies.

Opal.

Opal, *Werner*.

THIS subspecies is divided into seven kinds, viz. Precious Opal, Common Opal, Fire Opal, Mother-of-Pearl Opal or Cacholong, Semi-Opal, Jasper-Opal, and Wood Opal.

First Kind.

Precious Opal.

Edler Opal, *Werner*.

Opalus; Paederos, *Plinius*, l. xxxvii. 6.—Achates opalus, (irregular part), *Wall.* t. i. p. 280. *Id. Wud.* p. 325.—Opal, *Kirw.* vol. i. p. 289.—Edler Opal, *Emm.* b. i. s. 341.—Opalo, *Nap.* p. 197.—Opale, *Lam.* t. ii. p. 154.—L'Opale noble, *Broch.* t. i. p. 341. Quartz-resinite opalin, *Haüy*, t. ii. p. 434.—Edler Opal, *Reuss*, b. ii. s. 249. *Id. Lud.* *Id. Suck.* *Id. Bert.* *Id. Mohs*, b. i. s. 341. *Id. Karst.* Tabel. *Id. Leonhard*, Tabel. *Id. Hab.*—Silex opale, *Brong.* t. i. s. 300.—Quartz-resinite opalin, *Lucas*, p. 36. *Id. Brard*, p. 100.—Opal, *Kid*, vol. i. p. 227.—Quartz-resinite opalin, *Haüy*, Tabl. p. 27.—Edler Opal, *Steffens*, b. i. s. 135. *Id. Hoff.* b. ii. s. 136. *Id. Lenz*, b. i. s. 397. *Id. Oken*, b. i. s. 275. *Id. Haus.* Handb. b. ii. s. 422.

External Characters.

The most common colour of precious opal is milk-white, inclining to blue, which, when held between the eye and the light, appears pale wine-yellow; and it is sometimes yellowish-white. It almost always displays a beautiful play of colour, in which the tints are blue, green, yellow, and

and red. Generally several of these colours occur in one piece; but in some comparatively rare varieties, one tint predominates over the others. The rarest and most beautiful of these colours is the red*.

It occurs massive, disseminated, in plates, and in strings or small veins.

Internally its lustre is generally splendid, seldom passing into shining, and is vitreous.

The fracture is perfect conchoidal.

The fragments are indeterminate angular, and very sharp-edged.

It is translucent, and then it exhibits a red and green play of colours; or it passes from translucent into semitransparent, when it exhibits a most beautiful yellow colour; or it is semitransparent, approaching to transparent, when the principal colour is azure-blue.

It is semihard in a high degree.

It is brittle.

It is uncommonly easily frangible.

Some varieties adhere more or less to the tongue.

Specific gravity, 2.114, *Blumenbach*.—2.073, *Karsten*.—2.110, *Brisson*.

Chemical Characters.

Before the blowpipe it becomes opaque, and milk-white, but is infusible.

Constituent

* The play of colours is caused by numerous minute rents that traverse this mineral: thin layers of air are contained in them, and these have the property of reflecting the prismatic colours. It is a phenomenon analogous to the coloured rings observed by Newton.

Constituent Parts.

Silica,	-	-	90
Water,	-	-	10
			<hr/>
			100

Opal of Czscherwenitza, according to *Klaproth*.

Geognostic Situation.

It occurs in small veins in clay-porphry, generally accompanied with semi-opal; also in amygdaloid.

Geographic Situation.

It is found most abundantly in clay-porphry at Czscherwenitza, near Kaschau in Upper Hungary, where the famous opal-mines that afford all the opal of commerce are situated; sparingly in secondary amygdaloid in the Faroe Islands; and in trap rocks in the north of Ireland, at Sandy Brae. Formerly small portions of it were found in the mines near Freyberg in Saxony. De Dree mentions that it occurs also in South America*.

Uses.

Few gems are more beautiful than the opal. The elegant play of the richest, purest, and most beautiful colours, have procured for it a high rank among the precious stones. Notwithstanding its beauty, it is but indifferently suited to the purposes of jewellery, on account of its softness, great frangibility,

* It is mentioned in one of the public journals, that two mines of precious opal have been lately discovered in the district of Gracioso di Dios, sixty Spanish miles in the interior of Honduras.

frangibility, and its often splitting on a change of temperature. Jewels of opal must therefore be very carefully kept, because from their softness they easily scratch, and exposure to alternation of temperature, occasions them to split, by which their beauty is very much diminished. It is worked into ringstones, necklaces, ear-drops, and other ornaments. It is cut into a convex form, or *en cabochon*, with the view of showing its colours to the greatest advantage; but its softness prevents its being faceted, or if facets are cut on it, these must be very flat. The cutting is executed on a leaden wheel with water; and then it is polished with tin ashes, in a piece of chamois-leather, by which operation it receives its perfect lustre. When deficient in colour, jewellers are in the practice of setting it in a foil of the desired colour; but if it possesses a beautiful play of colour, it appears to the greatest advantage when set in a black case. At present, the opal is held in great estimation in all countries, but particularly in Hungary, Moldavia and Wallachia, where it forms the chief ornaments in the dress of the oldest and most wealthy families. It is exported to Turkey, and from thence it is frequently imported into Holland, where it is falsely denominated *oriental opal*. It is so highly esteemed by the Turks, that a fine opal of moderate size has sometimes been sold at the price of a diamond. It was much prized by the ancients. Pliny (the only one of the ancient writers who mentions the opal) describes it as uniting the beauties of the carbuncle, amethyst, and emerald; and the Greeks expressed their admiration of this lovely gem, by naming it *paederos*. Nonius, a Roman Senator, possessed an opal of extraordinary beauty, valued at L. 160,000; rather than part with which to Mark Antony, he chose to suffer exile. He fled to Egypt.

Egypt with his opal, where it was supposed he secreted it. It is not, after this, mentioned by any ancient writer; and the only other notice published in regard to it, is a story by a French interpreter Roboly, who pretended that he had discovered it amidst the ruins of Alexandria.

It does not appear that the opal was ever much used for engraving on, and very few engraved stones of this mineral are preserved in collections. The opal is frequently minutely disseminated through porphyry; and pieces of this kind, when cut and polished, are worked into snuff-boxes, and other similar articles.

Observations.

1. The peculiar play of colour distinguishes this mineral from all others. In all other characters it nearly agrees with Common Opal, differing principally in its higher degree of lustre and transparency.

2. This is one of the few minerals whose name has remained unaltered from the earliest times; but its origin or derivation is imperfectly known. Some derive it from the Greek word $\sigma\phi$ or $\sigma\phi\alpha\varsigma$, which signifies *vision*, because it was supposed to possess the power of strengthening the eye. The precious opal was the only kind known to the ancients.

3. The finer varieties are named *oriental opal*. Tavernier, however, informs us, that no precious opal is found in the East, and that those which are sold as oriental are brought from Hungary.

4. Those varieties of precious opal which adhere to the tongue, are only translucent, and scarcely exhibit any of the play of colour which so remarkably distinguishes the common varieties; but when immersed in water, they be-
come,

come more transparent, and acquire a very beautiful play of colour. This property of becoming transparent on immersion in water, occurs also in some varieties of common and semi-opal, and these have been described under various names, as *Oculus mundi*, and *Hydrophane*, or *Changeable Opal**. They are much prized by collectors on account of their rarity, and the property just mentioned. In order to preserve their beauty, we must be careful never to immerse them but in pure water, and to take them out again as soon as they have acquired their full transparency. If we neglect these precautions, the pores will soon become filled with earthy particles deposited from the water, and the hydrophane will cease to exhibit this curious property, and will always remain more or less opaque. When changeable opals are well dried, and immersed in melted wax or spermaceti, they absorb a portion of it, and become transparent, but on cooling become opaque again. For some time these prepared opals were imposed on the public as rare and singular minerals, and sold at a very high price, under the name *Pyrophane*.

5. In the Imperial Cabinet at Vienna, there are two pieces of opal from the mines in Hungary, which deserve to be mentioned here. The one is about five inches long and two and a half in diameter, and exhibits a very rich and splendid play of colours; the other, which is of the size and shape of a hen's egg, is also extremely beautiful.

Second

* These hydrophanes were known to the ancients under the name *Pantarchas*. Neuheuser, in his treatise intituled *Coronæ gemma nobilissimæ*, published in the sixteenth century, mentions the hydrophane, under the name *Verkehrstein* or *Wunderstein*.

Second Kind.

Common Opal.

Gemeiner Opal, *Werner*.

Wid. p. 325.—Semi-opal, *Kirw.* vol. i. p. 290.—Gemeiner Opal, *Emm.* b. i. s. 251.—Opalo, *Nap.* p. 197.—Girasol & Hydrophane, *Lam.* p. 156.—L'Opal commune, *Broch.* t. i. p. 344.—Gemeiner Opal, *Reuss*, b. ii. s. 253. *Id. Lud.* *Id. Suck.* *Id. Bert.* *Id. Mohs*, b. i. s. 344. *Id. Karsten*, Tabel. *Id. Leonhard*, Tabel.—Silex opale, *Brong.* t. i. p. 300.—Quartz-resinite commun, *Haüy*, Tabl. p. 28.—Gemeiner Opal, *Steffens*, b. i. s. 137. *Id. Lenz*, b. i. s. 400. *Id. Oken*, b. i. s. 275. *Id. Haus.* Handb. b. ii. s. 422. *Id. Hoff.* b. ii. s. 144.—Common Opal, *Aikin*, p. 178.

External Characters.

The principal colour of Common Opal is milk-white; but it occurs also greyish, yellowish, and greenish white. The milk-white passes into bluish-grey: and the greyish-white into smoke-grey: the yellowish-white into yellowish-grey, wax-yellow, honey-yellow, ochre-yellow, hyacinth-red, and an intermediate colour between flesh-red and brick-red: the greenish-white passes into apple-green, pistachio-green, and mountain-green. It never exhibits more than one colour. The milk-white variety, when turned round in the sun's rays, reflects a reddish colour. It is named *Girasol* *.

It occurs massive, disseminated, in sharp angular pieces, and very rarely vesicular.

Internally

* *Girasol* is derived from the Latin, *gyro*, to turn, and *sol*, the sun.

[Subsp. 4. *Opal*,—2d Kind, Common *Opal*.

Internally its lustre is generally splendid, sometimes passing into shining; and is vitreous.

The fracture is perfect conchoidal.

The fragments are indeterminate angular and sharp-edged.

It is most commonly semitransparent; sometimes it approaches to translucent, but seldom to transparent.

It scratches glass.

It is brittle.

It is uncommonly easily frangible.

It sometimes adheres to the tongue.

Specific gravity, 2.015, *Klaproth*.—2.144, *Kirwan*.—2.064, *Huberle*.

Chemical Characters.

Before the blowpipe it is infusible without addition.

Constituent Parts.

	Opal of Kosemutz.	Of Telkobanya.
Silica,	- 98.75	93.50
Alumina,	- 0.1	
Oxide of Iron,	- 0.1	1.0
Water,	- -	5.0
	98.95	99.50

According to *Klaproth*, t. ii. p. 164. & 169.

Geognostic Situation.

It occurs in veins along with precious opal in clay-porphry, and in short beds in primitive serpentine. It is also found in secondary amygdaloid, associated with calcedony, either in vesicular cavities, in cotemporaneous veins, or in short and thick beds. It also occurs in metalliferous veins,

veins, along with galena and blende, as in Saxony, Island of Elba, and in Bohemia ; or in red ironstone veins in Saxony. These veins traverse granite, gneiss, mica-slate, clay-slate or porphyry.

Geographic Situation.

It is found in metalliferous veins in Cornwall, in Iceland, the Faroe Islands, North of Ireland ; in the Electorate of Saxony, as at Freyberg, Hubertsberg, Eibenstock, Johanngeorgenstadt, and Schneeberg ; in Bohemia, as at Bleistadt, Fribus, Heinrichsgrün ; Brittany in France ; Silesia ; Poland ; Salzburg ; at Florence in Italy ; and Telkobanya in Hungary.

Uses.

It is cut for ornamental purposes : thus, the green-coloured Silesian variety is sometimes fashioned into ring-stones ; and the yellow variety, which was formerly named *wax-opal* and *pitch-opal*, is also cut and polished by jewelers.

Observations.

This mineral is characterised by its peculiar milk-white colour, strong lustre, perfect conchoidal fracture, considerable transparency, and its low degree of hardness and weight.

Third

*Third Kind.**Fire Opal.**Feur Opal, Karsten.*

Feur Opal, Karsten & Klaproth, Beit. iv. s. 156. *Id. Karsten*, p. 26. *Id. Steffens*, b. i. s. 138. *Id. Lenz*, b. i. s. 402. *Id. Oken*, b. i. s. 275. *Id. Haus. Handb.* b. ii. s. 423.

External Characters.

Its principal colour is hyacinth-red, which passes through honey-yellow into wine-yellow; and upon lighter places shews a carmine-red and apple-green iridescence. In its interior, dendritic delineations are sometimes to be observed.

Internally it is splendid, and the lustre is vitreous.

It occurs in distinct concretions, which are partly thick and curved lamellar, partly large and coarse granular.

The fracture is perfect conchoidal.

The fragments are indeterminate angular and sharp-edged, or tabular.

It is completely transparent.

It is hard.

It is uncommonly easily frangible.

Specific gravity 2.120, *Klaproth*.

Chemical Characters.

When exposed to heat, its colour changes into pale flesh-red; it becomes translucent, and traversed with numerous fissures.

Constituent Parts.

Silica,	-	92.00
Water,	-	7.75
Iron,	-	0.25
		<hr/>
		100.00

*Klaproth.**Geognostic and Geographic Situations.*

It has hitherto been found only in America, at Zimapan in Mexico, where it was first observed by Sonnenschmid and Humboldt. It occurs in a particular variety of horn-stone-porphry, which contains, besides the fire-opal, also imbedded lavender-blue grains the size of a pea, of a substance not unlike porcelain-jasper. In the middle of each grain of this blue substance, there is a whitish siliceous mineral, from which the blue mineral diverges in all directions in a stellar manner*.

Fourth Kind.

Mother-of-Pearl Opal, or Cacholong.

Perlmutter Opal, *Karsten.*

Achates opalinus, tenax, fractura inequalis, Cachalonius, Wall. gen. 20. sp. 126. p. 285.—*Calcedoine altérée, ou Cacholong, Romé de Lisle.*—*Calcedoine blanche opaque, De Born.*—*Cachelonio, Nap.*—*Silex cacholong, Brong. t. i. p. 302.*—*Cacholong, Kid, vol. i. p. 225.*—*Quartz-agathe cacholong, Haiiy, Tabl. p. 27.*—*Perlmutter opal, Steffens, b. i. s. 139. Id. Lenz, b. i. s. 404.*—*Kacholong, Oken, b. ii. s. 274.*

External

* Mr Heuland informs me he has specimens of this beautiful mineral from Guadalupe in Mexico, in cacholong.

External Characters.

Its colours are milk-white, yellowish-white, and greyish-white; sometimes dendritic.

It occurs massive; disseminated, in blunt angular pieces, in crusts, and sometimes reniform.

Externally it is dull; internally it alternates from dull to glistening and shining, and is pearly.

It sometimes occurs in coarse granular distinct concretions.

The fracture is flat conchoidal, but becomes earthy by the action of the atmosphere.

The fragments are indeterminate angular, and not particularly sharp-edged.

It is opaque.

It is somewhat harder than common opal.

It is brittle, and easily frangible.

Specific gravity, 2.209, *Karsten*.—2.272 *Ferroe*, *Kopp*.

Chemical Characters.

It is infusible before the blowpipe.

Geognostic and Geographic Situations.

It occurs, along with calcedony, in trap rocks in the island of Iceland; in the *Faroe Islands*; also in *Greenland*; and in *Bucharia*. At *Huttenberg* in *Carinthia*, it occurs along with compact and fibrous brown ironstone. It is also mentioned as a production of the *Island of Elba*, and of *Estremadura* in *Spain*.

Uses.

When cut, it is generally *en cabochon*; but it is seldom used for engraving upon, on account of its brittleness.

The

The Valentine III. in the Royal Library at Paris, is engraved upon cacholong. Italian artists sometimes use it for mosaic work, and Wallerius says the Calmuc Tartars fashion it into vessels of various kinds, and into idols.

Observations.

1. Some mineralogists consider it as a variety of Calcedony; but it is distinguished from that mineral by lustre, fracture, hardness, and specific gravity.

2. The name *Cacholong*, is by some derived from a supposed river in Bucharia, named Cach, where the mineral is said to have been first found: but as there is no river of that name in Bucharia, other mineralogists have derived the name from *cholong*, that is, a stone, and *cach*, which in the language of that country signifies a pebble; while Blumenbach says, that *cacholong* is a Mongolian word signifying a beautiful stone.

Fifth Kind

Semi-Opal.

Halb-Opal, *Werner*.

Id. Wid. p. 325.—Semi-opal, and several of the Pitchstones of *Kirn.* vol. i. p. 290. 292.—Halb-Opal, *Emm.* b. i. s. 256. *Id. Estner*, b. ii. s. 429.—Semi-opalo, *Nap.* p. 201.—Pissite, *Lam.* t. ii. p. 160.—La Demi-opal, *Broch.* t. i. p. 347.—Quartz-resinite commun, *Häuy*, t. ii. p. 433.—Halb-Opal, *Reuss*, b. ii. s. 257. *Id. Lud.* b. i. s. 97. *Id. Suck.* 1st th. s. 311. *Id. Bert.* s. 266. *Id. Mohs*, b. i. s. 355. *Id. Hab.* s. 8.—Quartz-resinite commun, *Lucas*, p. 36.—Halb-Opal, *Leonhard*, Tabel. s. 13.—Silex Resinite, *Brong.* t. i. p. 303.—Halb-Opal, *Karsten*, Tabel, s. 26.—Semi-opal, *Kid*, vol. i. p. 231.—Quartz-resinite

[Subsp. 4. Opal,—5th Kind, Semi-Opal.

resinite Hydrophane, *Haidy*, Tabl. p. 27.—Halbopal, *Steffens*, b. i. s. 141. *Id. Hoff.* b. ii. s. 140. *Id. Lenz*, b. i. s. 406. *Id. Oken*, b. i. s. 276. *Id. Haus.* b. ii. s. 424.—Semi-opal, *Aikin*, p. 179.

External Character.

Its most common colours are white, grey and brown. Of white, the varieties are yellowish-white, and greyish-white, seldom milk-white and greenish-white. It passes from ash-grey into greyish-black; from yellowish-grey into wax-yellow, into a colour intermediate between ochre and isabella yellow, into yellowish-brown, hair-brown, liver-brown, chesnut-brown, reddish-brown, and nearly into red; and, lastly, from greenish-grey into leek-green, olive-green, and oil-green.

Sometimes several colours occur together, and these are arranged in spotted, concentric striped, clouded, or flamed delineations; but it is most commonly uniform, or of one colour.

It occurs not only massive and disseminated, but also tuberosé, small reniform, small botryoidal, and stalactitic.

Externally it is glistening; internally, generally glistening, sometimes approaching to shining, or passing into glimmering.

The fracture is large and flat conchoidal, but less perfect than that of common opal; and it sometimes inclines to small conchoidal.

The fragments are indeterminate angular and very sharp-edged.

It is more or less translucent, and sometimes passes to translucent on the edges.

It is semihard, approaching to hard.

It is rather easily frangible.

Specific gravity,—Yellowish and greenish-grey from Hungary, 2.000, *Hoff.* Yellowish-white from Steinheim, 2.001, *Hoff.* Blackish-brown from Steinheim, 2.059, *Hoff.* Milk white from Freyberg, 2.167, *Hoff.* From Moravia, 2.167, *Klap.* 2.077, 2.187, *Karsten.*

Chemical Characters.

It is infusible before the blowpipe without addition; but with borax it melts, and without intumescing.

Constituent Parts.

Semi-opal from Neu Wieslitz, between Brunn and Kremsier in Moravia:

Silica,	-	85.00
Alumina,	-	3.00
Oxide of Iron,	-	1.75
Carbon,	-	5.00
Ammoniacal Water,		8.00
Bituminous Oil,	-	0.33
		<hr/>
		99.08

Klaproth, *Beit. b. v. s.* 31.

Geognostic Situation.

It occurs in angular pieces, beds, and veins, in porphyry and amygdaloid; also in metalliferous (most usually silver) veins that traverse granite and gneiss.

Geographic Situation.

It is found in Greenland, Iceland, Faroe Islands, Scotland, in the Isle of Rume, where it occurs in amygdaloid;
Electorate

[Subsp. 4. *Opal*,—5th Kind, *Semi-Opal*

Electorate of Saxony, Bohemia, Frankfort on the Mayne, Silesia, Lower Austria, Poland, Hungary, Transylvania, Isle of Elba, Piedmont, and Siberia.

Observations.

1. It is distinguished from *Common Opal* by the mud-diness of its colours, its particular external shapes, its inferior lustre and transparency, its less perfect conchoidal fracture, and its greater hardness and weight.

2. It passes into Opal-Jasper, Calcedony, and Conchoidal Hornstone.

3. It has been arranged with Pitchstone by Dolomieu, Fichtel, and other mineralogists; but it is distinguished from that mineral by its vitreous lustre, greater transparency, inferior specific gravity, its want of distinct concretions, and its infusibility.

Sixth Kind.

Jasper-Opal, or Ferruginous Opal.

Opal-Jaspis, *Wernur*.

Jaspe-Opale, *Broch.* t. ii. p. 498.—Opal-Jaspis, *Reuss*, b. ii. s. 317. *Id.* *Lud.* b. i. s. 95. *Id.* *Mohs*, b. i. s. 324. *Id.* *Leonhard*, Tabel. s. 12.—Jasp-Opal, *Karsten*, Tabel. s. 26.—Jasp-opal, *Steffens*, b. i. s. 143.—Opal Jaspis, *Hoff.* b. ii. s. 177.—*Id.* *Lenz*, b. ii. s. 411.—Jasp-opal, *Oken*, b. i. s. 277.—Eisen-opal, *Haus.* b. ii. s. 428.—Ferruginous Opal, *Aikin*, p. 179.

External Characters.

Its colours are scarlet-red, light blood-red, brownish-red, ochre-yellow, isabella-yellow, yellowish-grey, and ash-grey.

The isabella-yellow passes into yellowish-white; and the blood-red into reddish-brown:

The colour is either uniform, or distributed in spotted, veined, and clouded delineations.

It occurs massive.

Internally its lustre is shining, approaching to splendid, and is intermediate between vitreous and resinous.

The fracture is perfect conchoidal, and sometimes rather flat conchoidal.

The fragments are indeterminate angular, and very sharp-edged.

It is opaque, and sometimes feebly translucent on the edges.

It is intermediate between hard and semihard.

It is easily frangible.

Specific gravity,—

Yellow and red striped from Constantinople, 1.863. *Hoff.*

Red from Lauenhayn, - - - 2.053, *Hoff.*

Brownish-red from Telkobanya, - - 2.061, *Hoff.*

Reddish-brown from Telkobanya, { 2.072, } *Hoff.*
 { 2.081, }

Chemical Characters.

• It is infusible before the blowpipe.

Constituent Parts.

• Silica,	-	-	43.5
Oxide of Iron,	-	-	47.0
Water,	2	-	7.5
			<hr/>
			98.0

Klaproth, Beit. b. ii. s. 164.

Geognostic

Geognostic and Geographic Situation.

It is found in large and small pieces in porphyry, near Telkobanya, and Tokay in Hungary; in the Mittelgebirge in Bohemia*; near Constantinople; in the Kolyvanian mountains in Siberia; and in veins in the Saxon Erzgebirge.

Observations.

It used to be arranged as a subspecies of *Jasper*; but its perfect conchoidal fracture, high lustre, great brittleness, and inferior weight, sufficiently distinguish it from the different subspecies of *Jasper*.

Seventh Kind.

Wood-Opal.

Holz-Opal, Werner.

Id. Wid. p. 325.—Ligniform Opal, *Kirw.* vol. i. p. 295.—*Holz-opal, Emm.* b. i. s. 260.—Semi-opalo, *Nap.* p. 201.—*Xilopale, Lam.* t. ii. p. 102.—Opal ligniforme, *Broch.* t. i. p. 350.—*Holz-Opal, Reuss,* b. ii. s. 267. *Id. Lud.* b. i. s. 98. *Id. Suck.* 1^r th. s. 317. *Id. Bert.* s. 267. *Id. Mohs,* b. i. s. 340. *Id. Leonhard,* Tabel. s. 13. *Id. Karst.* Tabel. s. 26.—Quartz-resinite xyloïde, *Haüy,* Tabl. p. 28.—*Holz-opal, Steffens,* b. i. s. 144. *Id. Hoff.* b. ii. s. 153. *Id. Lenz,* b. i. s. 413. *Id. Oken,* b. i. s. 276.—Wood Opal, *Aikin,* p. 179*

External Characters.

It occurs most commonly white, grey, or brown, and sometimes also black. The white varieties are milk-white, yellowish-

* Heuland.

yellowish-white, and greyish-white: the greyish-white passes into ash-grey, pearl-grey, smoke-grey, and yellowish-grey; which latter passes into ochre-yellow, yellowish-brown, wood-brown, hair-brown, and the greyish-white passes into greyish-black.

The colour is sometimes simple, sometimes in flamed and striped delineations, which are conformable with the original texture of the wood.

It occurs in pieces which have the shape of branches and stems.

Internally its lustre is shining, which sometimes passes on the one hand into splendid, and on the other into glistening, and even into glimmering.

The cross fracture is large and flat conchoidal; the longitudinal fracture is sometimes modified by the remaining fibrous woody texture.

The fragments are sometimes indeterminately angular and sharp-edged, sometimes long splintery.

It is more or less translucent; sometimes only translucent on the edges.

It is semihard in a high degree.

It is easily frangible.

Specific gravity, 2.080, 2.100, *Kirwan*.—2.048, 2.059, *Hoff.*; also 2.189, *Hoff.*

Geognostic and Geographic Situations.

It is found in alluvial land at Zastravia in Hungary; and is said to occur in secondary trap rocks in Transylvania. It has also been found in the neighbourhood of Fain, near Telkobanya in Upper Hungary. Many years ago the trunk of a tree penetrated with opal was found in Hungary,

[Subsp. 4. *Opal*,—7th Kind, *Wood-Opal*.

ry, which was so heavy that eight oxen were required to draw it.

Observations..

1. Its woody texture distinguishes it from the other subspecies of *Opal*: and it is distinguished from *Woodstone* by its lighter colours, higher lustre, perfect conchoidal fracture, greater transparency, and inferior hardness and weight.

2. It is wood penetrated with opal, and is intermediate between Common Opal and Semi-Opal.

Uses.

It is cut into plates, and is then used for snuff-boxes, and other ornamental articles.

Fifth Subspecies.

Menilite.

THIS subspecies is divided into two kinds, viz. **Brown Menilite**, and **Grey Menilite**.

First Kind.

Brown Menilite.

Brauner Menilite, Hoffmann.

Leberopal, *Reuss*, b. ii. s. 265.—**Menilite**, *Lud.* b. ii. s. 141.—**Leberopal**, *Suck.* 1r th. s. 316.—**Knollenstein**, *Mohs*, b. i. s. 343.—**Leberopal**, *Hab.* s. 9.—**Menilite**, *Leonhard*, Tabel. s. 13.—**Leberopal**, *Karst.* Tabel. s. 26.—**Silex Menilite**, *Brong.* t. i. p. 312.—**Menilite**, *Kid*, vol. i. p. 232.—**Quartz-resinite subluisant, brunatre**, *Haüy*, Tabl. p. 28.—**Menilith**, *Steffens*, b. i.

b. i. s. 145.—Brauner Menilite, *Hoff.* b. ii. s. 156.—Leberopal, *Lenz*, b. i. s. 410.—Kalkopal, or Knollenstein, *Oken*, b. i. s. 276.

External Characters.

Its colour is chesnut-brown, which inclines to liver-brown. On the surface, it has sometimes a bluish colour.

It occurs always tuberoso, seldom larger than a fist, often smaller.

The external surface is rough and dull; internally it is faintly glistening, and the lustre is intermediate between resinous and vitreous.

It sometimes has a tendency to lamellar distinct concretions.

The fracture is very flat conchoidal.

The fragments are indeterminate angular and very sharp-edged.

It is translucent on the edges.

It scratches glass.

It is easily frangible.

Specific gravity, 2.185, *Klaproth*.—2.168, *Brisson*.—2.176, *Haberle*.—2.161, 2.169, *Hoffmann*.

Chemical Characters.

It is infusible before the blowpipe without addition.

Constituent Parts:

Silica,	-	-	-	85.5
Alumina,	-	-	-	1.0
Lime,	-	-	-	0.5
Oxide of Iron,	-	-	-	0.5
Water, and Carbonaceous Matter,				11.0
				<hr/>
				98.5

Klaproth, *Beit.* b. ii. s. 169.

Geognostic

Geognostic and Geographic Situations.

It has hitherto been found only at Menil Montant, near Paris, where it occurs imbedded in adhesive-slate, in the same manner as flint is in chalk. It is worthy of remark, that the direction of the thin lamellar concretions of the menilite correspond with that of the slaty structure of the adhesive-slate in which it is imbedded. This fact shews that the menilite and slate are of cotemporaneous formation.

Observations.

1. This subspecies is distinguished from the following, or the *Grey Menilite*, by its brown colour, its internal lustre, its more perfect conchoidal fracture, its translucency on the edges, its inferior weight, and geognostic situation.

2. It is nearly allied to semi-opal; but it is distinguished from it by colour, shape, feebler lustre, inferior translucency, greater weight, and geognostic situation.

3. It was at one time arranged along with Pitchstone, under the name *Blue Pitchstone*: more lately it has been described as a member of the Opal species, under the title *Liver Opal*, (*Leberopal*).

*Second Kind.**Grey Menilite.*

Grauer Menilite, Hoffmann.

External Characters.

Its colour is yellowish-grey, which sometimes inclines to wood-brown.

It occurs tuberosc, but more compressed than in the brown subspecies, and the external surface is smoother.

Internally it is glimmering or dull.

The fracture is very flat conchoidal, and is sometimes almost even.

The fragments are indeterminate, angular and sharp-edged.

It is very feebly translucent on the edges, and sometimes quite opaque.

It is semihard in a high degree.

It is easily frangible.

Specific gravity 2.286, 2.375, *Hoff.*

Geognostic and Geographic Situations.

It occurs at Argenteuil near Paris, imbedded in a clayey marl: also in gypsum which alternates with this marl. It has also been found at St Ouen, near Paris; and, according to Häüy, on the Maase.

Sixth Subspecies.

Obsidian.

THIS Subspecies is divided into two Kinds, viz. Translucent Obsidian and Transparent Obsidian.

First Kind.

Translucent Obsidian.

Durchscheinender Obsidian, Hoffman.

Lapis Obsidianus? *Plin.* Hist. Nat. xxxvi. 26. s. 67.—*Achatos islandicus*, *Wall.* t. ii. p. 378.—*Pumex vitreus solidus*, *Syst. Nat.*

Nat. xii. 3. p. 182. n. 7.—Verré de volcan en masses irréguliers, Pierre obsidienne, Pierre de gallinace, & Agathe noir d'Islande, *Romé de Lisle*, t. ii. p. 635.—Verre ou Laitier de volcan, *Faujas*, des Volcans, p. 308.—Obsidian, *Wid.* s. 348. *Id. Kirw.* vol. i. p. 265.—Obsidian, *Nap.* p. 205.—*Retzius*, De lapide Obsidiano, Lund. Goth. 1799, 4to.—Lave vitreuse obsidienne, *Hall*, t. iv. p. 494.—Obsidian, *Reuss*, b. ii. s. 355. *Id. Lud.* b. i. s. 85. *Id. Suck.* 1^r th. s. 371. *Id. Bert.* s. 270. *Id. Mohs*, b. i. s. 349. *Id. Hab.* s. 15.—Lave vitreuse obsidienne, *Lucas*, p. 231.—Obsidienne, *Brong.* t. i. p. 355.—Lave verre noire, *Brard*, p. 447.—Obsidian gemeiner, *Leonhard*, Tabel. s. 14.—Obsidian, *Karsten*, Tabel. s. 36.—Obsidian, *Kid*, Appendix, p. 38. *Id. Steffens*, b. i. s. 371.—Durchscheinender Obsidian, *Hoff.* b. ii. s. 191.—Gemeiner Obsidian, *Lea*, b. i. s. 432.—Obsidian, or Lava-glass, *Oken*, b. i. s. 305.—Gemeiner Obsidian, *Haus. Handb.* b. ii. s. 432.

External Characters.

Its most frequent colour is velvet-black, which sometimes passes on the one side into greyish-black, ash-grey, and smoke-grey, and on the other into pitch-black. Some varieties are olive-green, and exhibit a beautiful silvery, or golden opalescence. The colour is generally uniform, seldom spotted or striped.

It occurs massive, in blunt-cornered pieces, and sometimes in original grains, which are angular or roundish.

The external surface of the blunt-cornered pieces is rough; that of the grains sometimes rough, sometimes smooth.

Internally it is specular, splendid, seldom shining, and the lustre is vitreous.

The fracture is perfect, large, and rather flat conchoidal.

It breaks into angular and very sharp-edged fragments, which sometimes incline to the tabular form.

Abilgaard is of opinion, that the loss in his analysis was owing to the escape of either potash or soda.

	American.	American. •	American.
Silica, - - -	72.0	72.0	71.0
Alumina, - - -	12.5	14.2	13.4
Natron and Potash, -	10.0	3.3	5.0
Lime, - - -	0.0	1.2	1.6
Oxide of Iron & Manganese,	2.0	3.0	4.0
	<hr/> 96.5	<hr/> 93.7	<hr/> 95.0
	<i>Collet-Descotils.</i>	<i>Drappier.</i>	<i>Drappier.</i>

Geognostic Situation.

This mineral occurs in beds, and imbedded masses and veins, in porphyry, and in various secondary trap rocks. Sometimes it contains grains and crystals of felspar, when it forms obsidian porphyry.

Geographic Situation.

Europe.—This singular mineral is found in different parts of Europe. The island of Iceland, so remarkable on account of its volcanoes and hot springs, contains beds of this kind of obsidian. According to Shumacher, a bed of obsidian two feet thick, occurs in the Bordafield Syssel in Iceland; and Sir George Mackenzie, during his journey through that remote and desolate country, observed a great mass of obsidian, which appeared to him to be part of a stream that had flowed from a volcano. It is also found in the mountains of Tokay in Hungary, imbedded in pearlstone-porphry; and in the same geognostic situation in Spain. It occurs in several of the islands in the Mediterranean, as Milo, Candia, and the Lipari Islands*.

Africa.

* Vid. Account of the Obsidian of Lipari, by Spallanzani in his *Travels*, and Colonel Imric, in the 2d volume of the *Memoirs of the Wernerian Society*.

Africa.—According to Cordier and Humboldt, it occurs at the summit of the Peak of Teneriff; and Dr Forster observed it in great quantity in the Isle of Ascension. It is said also to occur in the Island of Madagascar.

Asia.—Siberia; and near the town Goda, twenty wersts from Teflis in Georgia.

America.—Humboldt and Sonrenschmidt found beds and mountain-masses of obsidian at great heights, both in Peru and Mexico.

Polynesia.—Dr Forster found obsidian in several of the islands in the South Sea, as Easter Island, and Roggewein's Island.

Uses.

Although it can be cut and polished, yet its brittleness and frangibility are so great, that it is very apt to fly in pieces during the working: hence it is but seldom used by jewellers. Danish lapidaries cut the obsidian of Iceland into snuff-boxes, ring-stones, and ear-drops. The beautiful olive-green opalescent variety from Mexico, is cut and polished, and used for ring-stones or brooches. It has very much the appearance of cat's-eye, and has been passed for such by jewellers. According to Pliny, the ancients are said to have formed obsidian into mirrors, and into ornamental articles. In New Spain and Peru, the natives cut it into mirrors; and formerly they used to manufacture it into knives, and other cutting instruments. Hernandez saw more than 100 of these knives made in an hour. Criez, in his letter to the Emperor Charles V. relates that he saw at Tenochtitlan, razors made of obsidian; and Von Humboldt examined the mines which afforded the obsidian for these purposes on the Serro de las Novajas, or the *Mountain of Knives*. The natives of Easter and Ascension islands

use

[Subsp. 6. Obsidian,—1st Kind, Translucent Obsidian.

use it in place of cutting instruments; also for pointing their lances and spears, and for striking fire with.

Observations.

1. It was first introduced into the oryctognostic system by Werner. Its name is of great antiquity, being derived from a Roman named Obsidius, who first brought it from Ethiopia to Rome. Pliny speaks of it in the following lines: "In genere vitri et obsidiana numerantur, ad similitudinem lapidis quem in Æthiopia invenit Obsidius, nigerrimi coloris, aliquando et translucidi, crassiori visu, atque in speculis parietum pro imagine umbras redente," &c.

2. It passes into Pitchstone, Pearlstone, and Pumice.

3. The resemblance of this mineral to glass, and its frequent occurrence in the neighbourhood of volcanoes, has induced some mineralogists to consider it as of volcanic origin, while others, from its alternation with porphyry rocks, maintain that it is of Neptunian formation. Werner, Hoffmann, Steffens, and Mohs, are of opinion that it is an aquatic production; whereas Faujas St Fond, Von Buch, Cordier, and Häuy, maintain its volcanic origin.

Second Kind.

Transparent Obsidian.

Durchsichtiger Obsidian, *Hoffmann*.

Marekanit, *Karst.* Tabel. s. 36.—Obsidienne de Marikan, *Brong.* t. i. p. 432.—Edler Obsidian, *Haus.* s. 87.—Durchsichtiger Obsidian, *Hoff.* b. ii. s. 200.—Marekanit, *Lenz*, b. i. s. 435.
Id. Oken, b. i. s. 305.—Edler Obsidian, *Haus. Handb.* b. ii. 432.

External

External Characters.

The colours are duck-blue, greyish-white, and clove-brown.

The blue occurs only massive; the white and brown in large and small grains.

The surface of the grains is smooth.

Internally it is splendid.

The fracture is perfect conchoidal.

It breaks into intermediate angular and sharp-edged fragments.

It is perfectly transparent.

It is hard.

It is brittle.

It is very easily frangible.

Specific gravity, 2.333, 2.360, *Lowitz*.—2.365, *Blumenbach*.—2.366, *Hoff*.—2.365, *Klaproth*.

Chemical Characters.

According to Link, it melts more easily than the translucent obsidian, and into a white muddy glass.

Constituent Parts.

Silica,	-	-	81.00
Alumina,	.	-	9.50
Lime,	-	-	0.33
Oxide of Iron,	-	-	0.60
Potash,	-	-	2.70
Natron,	-	-	4.50
Water,	-	-	0.50

99.13 *Klaproth*.

Geognostic Situation.

It occurs imbedded in pearlstone-porphry.

Geographic Situation.

The white and brown varieties are found at Marekan, near Ochotsk in Siberia; the brown variety at Cape de Gate in Spain; and the blue variety in the Serro de las Novajas in Mexico.

Observations.

This kind is characterized by its colour and transparency.

Seventh Subspecies.

Pitchstone.

Pechstein, *Werner*.

Id. Wid. s. 332.—Pitchstone, *Kirw.* vol. i. p. 292.—Pechstein, *Estner*, b. ii. s. 435. *Id. Emm.* b. i. s. 262.—Pietra picea, *Nap.* p. 203.—Pissite, var. h. *Lam.* t. ii. p. 162.—La Pierre de Poix, *Broch.* t. i. p. 353.—Petrosilex resini forme, *Huy,* t. iv. p. 386.—Pechstein, *Reuss*, b. ii. s. 345. *Id. Lud.* b. i. s. 98. *Id. Such.* 1st th. s. 321. *Id. Bert.* s. 225. *Id. Hab.* s. 15.—Resinite, *Brong.* t. i. p. 345.—Pechstein, *Haus.* s. 87. *Id. Leonhard,* Tabel. s. 13. *Id. Karst.* Tabel. s. 36. *Id. Kid,* vol. i. p. 231.—Pechstein, *Steffens*, b. i. s. 375. *Id. Hoff.* b. ii. s. 202. *Id. Lenz,* b. i. s. 436. *Id. Oken,* b. i. s. 304.—Pitchstone, *Aikin,* p. 203.

External Characters.

The principal colour is green, from which it passes on the one side into black, grey, and blue, and on the other, through

through several varieties of green, into brown, yellow, and red; yellow and blue are the rarest colours. The green colours are blackish-green, mountain-green, leek-green, olive-green, and oil-green. From blackish-green it passes into greenish-black, bluish-black, greyish-black, ash-grey, smoke-grey, and a colour intermediate between indigo and Berlin blue: from olive-green and oil-green into liver-brown, reddish-brown, and pale blood-red. The yellowish-grey sometimes approaches to ochre-yellow. These colours are seldom bright, most generally dull and deep. The colour is in general uniform, seldom in veined, clouded, and spotted delineations.

It occurs massive, sometimes in distinct concretions, which are coarse, seldom large and flat granular; sometimes thick and wedge-shaped prismatic; and rarely thick and straight lamellar. The surface of the distinct concretions is generally smooth and shining, and sometimes rather curved.

Internally it is shining, sometimes passing into glistening, even inclining to glimmering. The red has the feeblest, the bluish and the green the strongest lustre; and the luster is vitreo-resinous.

It is feebly transparent on the edges.

The fracture is imperfect conchoidal*, and is sometimes large and flat, sometimes small conchoidal: from the latter it passes into coarse-grained uneven, which sometimes approaches to coarse splintery. The conchoidal has the strongest, the splintery the weakest, lustre.

It breaks into angular and sharp-edged fragments.

It is semi-hard in a high degree.

* Some varieties of the Arran pitchstone have a perfect and large conchoidal fracture: this, with their lamellar concretions, distinguishes them from the more common varieties of this mineral.

It is rather easily frangible.

Specific gravity, 2.196 to 2.389, *Hoff.*—2.314 to 2.319, *Brisson.*

Chemical Characters.

Before the blowpipe it is fusible without addition. The black variety of Arran at 21° of Wedgwood's pyrometer, intumescenced a little, its colour was slightly altered, the surface glazed, and internally porous; at 31°, intumescenced considerably and softened; at 65°, the intumescence was more considerable; at 100°, it was still vesicular, but more compact. The blackish-green variety of Arran becomes black, is much rent, and internally porous at 23°; at 55° formed a porous enamel; at 70° it became perfectly white, and still porous. The pitchstones of Meissen in Saxony, according to Mr Kirwan, appear to be more infusible than those of Arran. He found some to melt at 130° Wedgwood; others at 152° to 165°; and a red variety remained nearly unaltered at 160°.

Constituent Parts.

Pitchstone of Meissen.

Silica,	-	-	73.00
Alumina, $\frac{1}{2}$,	-	-	14.50
Lime,	-	-	1.00
Oxide of Iron,	-	-	1.00
Oxide of Manganese,	-	-	0.10
Natron,	-	-	1.75
Water.	-	.	8.50
			<hr/>
			99.85

Klap. Beit. b. iii. s. 257.

Geognostic Situation.

It occurs in veins that traverse granite; in beds and veins in porphyry, and in the old red sandstone formation; and in veins and imbedded portions in secondary trap rocks.

Geographic Situation.

Europe.—Pitchstone occurs in considerable abundance in different parts in Scotland *. In the Island of Arran it traverses granite in the form of veins; in the red sandstone of that island it appears in beds, and veins of very considerable magnitude; and in small veins in the trap rocks of the Isle of Lamlash. In the islands of Mull, Canna, and Skye, it occurs either imbedded, or in the form of veins in secondary trap and porphyry rocks. Near Eskdalemuir, in the mountainous parts of Dumfriesshire, it rests upon transition rocks, and is associated with secondary trap rocks. I am told that it occurs in trap rocks in Ardnamurchan in Argyleshire. Dr MacCulloch found it in granite near the summit of Cairngorm; I found it at Cumberhead in Lanarkshire; and my friend Dr Murray, several years ago, observed black pitchstone amongst trap rocks on the summits of the Cheviot Hills.

In Ireland, it occurs in a vein traversing granite, in the Townland of Newry †, where it was first observed by Mr Joy of Dublin.

It occurs in the Island of Iceland in secondary trap rocks ‡.

This

* Vid. Jameson's Mineralogical Travels; and Mineralogical Description of Dumfriesshire.

† Fitton's Mineralogy of Dublin, p. 53.

‡ Sir George Mackenzie's Travels in Iceland.

[*Subsp. 7. Pitchstone.*

This mineral has never been found in the Scandinavian Peninsula. It occurs in the Electorate of Saxony, near Meissen, along with porphyry and sienite, which rest upon gneiss; in a similar formation at Braunsdorf, Spechtshausen and Mohorn, between Dresden and Freyberg, near Dittersdorf, and at Planitz, near Zwickaw. The blue variety of pitchstone occurs near Vicenza in Italy, and probably in secondary trap rocks *. Pitchstone occurs in porphyry between Schemnitz and Kremnitz, and also near Tokay in Hungary; and in several of the islands in the Mediterranean, it appears to be associated with porphyry.

Asia.—It occurs at Kolyvan in Siberia, and near Mursink, in the Uralian mountains.

America.—In Mexico, according to Sonnendsmidt, it occurs in great abundance, associated with clay-porphyry †.

In South America it occurs at Pasto, Popayan, and Quito, along with clay-porphyry.

Observations.

1. It has been confounded with *Semi-Opal*: but it is distinguished from it by the following characters: its colour-suite is more extensive, and the colours are duller and more muddy than those of semi-opal: its lustre is vitreo-resinous; but that of semi-opal is vitreous: its fracture is imperfect conchoidal; that of semi-opal perfect conchoidal: it is rather heavier than semi-opal, and is differently affected by the blowpipe.

2. It

* In the Isle of Eigg, there is a blue variety of pitchstone, occurring in secondary trap, which resembles that of Vicenza.

† It is said to occur in serpentine at the Bare Hills, seven miles from Baltimore in Maryland.—*Cleveland's Mineralogy*, p. 251.

2. It is named *Pitchstone*, from the striking resemblance which some of its varieties have to pitch.

3. It was first discovered, about seventy years ago, by a mineralogist of Dresden, named Schulz; but it was first established as a distinct species by Werner.

4. It appears to pass on the one hand into Obsidian, and on the other into Pearlstone.

Eighth Subspecies.

Pearlstone.

Perlstein, *Werner*.

Le Perlstein, *Broch.* t. i. p. 352.—Lave vitreuse perlée, *Hallé*, t. iv. p. 495.—Perlstein, *Reuss*, b. ii. s. 349. *Id.* *Lud.* b. i. s. 99. *Id.* *Suck.* 1^{re} th. s. 367. *Id.* *Bert.* s. 224. *Id.* *Mohs*, b. i. s. 353.—Lave vitreuse perlée, *Lucas*, p. 231.—Obsidienne perlée, *Brong.* t. i. p. 340.—Perlstein, *Haus.* s. 88.—Pearlstein, *Leonhard*, *Tabel.* s. 14. *Id.* *Karsten*, *Tabel.* s. 36.—Pearlstone, *Kül.* Appendix, p. 38.—Perlstein, *Steffens*, b. i. s. 378. *Id.* *Hoff.* b. ii. s. 208. *Id.* *Lenz*, b. i. s. 443. *Id.* *Oken*, b. i. s. 306. *Id.* *Haus.* Handb. b. ii. s. 432.—Pearlstone, *Aikin*, p. 203.

External Characters.

Its colour is generally grey, sometimes also black and red. The varieties of grey are smoke, bluish, ash, yellowish, and pearl grey: from dark ash-grey it passes into greyish-black: from yellowish-grey into a kind of straw-yellow: from pearl-grey into flesh and brick-red, and reddish-brown. The colours are sometimes disposed in striped and spotted delineations.

It occurs massive, vesicular; and the vesicles are sometimes round, and sometimes so much elongated, that the

mass appears fibrous; ~~also, in large~~ and coarse angulogranular distinct concretions, ~~that~~ include small and round granular concretions, which are again composed of very thin concentric lamellar concretions. The surface of the concretions, particularly in the large and coarse granular, is smooth, shining, and pearly, and has a striking resemblance to that of pearl. In the centre of these concretions, we frequently meet with roundish balls of obsidian.

Its lustre is shining and pearly.

Its fracture, on account of the thinness of the distinct concretions, is hardly observable, but appears to be small and imperfect conchoidal.

The fragments are indeterminate angular and blunt-edged.

It is translucent on the edges, sometimes even translucent.

It is uncommonly easily frangible.

It is soft, passing into very soft.

Specific gravity, Mexican, 2.254, *Vauquelin*.—Hungarian, 2.340, *Klaproth*.—Hungarian, 2.343, *Hoff*.

Chemical Characters.

Before the blowpipe it intumesces very much, and is converted into a white spumaceous glass.

Constituent Parts.

Pearlstone of Hungary.				Pearlstone of Mexico.			
Silica,	-	-	75.25	Silica,	-	-	77.0
Alumina,	-	-	12.00	Alumina,	-	-	13.6
Oxide of Iron,	-	-	1.60	Oxide of Iron & Manganese,	-	-	2.0
Potash,	-	-	4.50	Potash,	-	-	2.0
Lime,	-	-	0.50	Lime,	-	-	1.6
Water,	-	-	4.50	Natron,	-	-	0.5
				Water,	-	-	4.0
			98.35				100.2

Klaproth, *Beit. b. iii. s. 326*

Vauquelin.
Göppert.

Grognostic Situation.

It occurs in great beds in clay-porphry, and both rocks contain imbedded cotemporaneous balls of hornstone. It is frequently intermixed with felspar, mica, and quartz, and thus acquires a porphyritic character. It has also been found in secondary trap rocks.

Geographic Situation.

Europe.—It occurs in large beds, in porphyry, near Tokay, Keresztur, and Telkebanya, in Hungary; also at Schennitz, Glasshütte and Kremnitz, in the same country. It is said to occur at Carbonera, at Cape de Gate in Spain, where it is associated with obsidian. It occurs, along with porphyry, near Sandy Brac in Ireland; and in secondary trap rocks in the Island of Iceland*.

Asia.—Beautiful varieties of this mineral occur near Ochotsk.

America.—It occurs, along with porphyry, in Mexico.

Observations.

1. The distinct concretions distinguish this species from all the other members of the *Pitchstone* family: it is further characterized by its colour-suite, kind of lustre, great frangibility, and low degree of hardness.

2. Some mineralogists describe it as a variety of Obsidian; others as a Zeolite, under the title *Volcanic Zeolite*; but Werner, with more propriety, views it as a species distinct from either of these, and, from the resemblance of the most characteristic varieties to Pearl in colour, lustre, and form, names it *Pearlstone*.

Ninth

* Mackenzie's Travels in Iceland.

Ninth ¹⁷¹Subspecies.

Pumice.

Bimstein, *Werner*.

Pumex, *Plin. Hist. Nat.* xxx. 21.—Porus igneus, *Wall. t. ii.* p. 375.—Punex vulcani, *Romé de Lisle, t. ii.* p. 629.—Bimstein, *Wid. p.* 350.—Pumice, *Kirn. vol. i.* p. 415.—Bimstein, *Emm. b. i. s.* 350.—Pumice, *Nap. p.* 208.—Pierre-ponce, *Lam. t. ii. p.* 473.—La Pierre-ponce, *Broch. t. i. p.* 443.—Lave vitreuse pumicée, *Hall, t. iv. p.* 495.—Bimstein, *Reuss, b. ii. s.* 261. *Id. Lud. b. i. s.* 125. *Id. Suck. 1^r th. s.* 374. *Id. Bert. s.* 204. *Id. Mohs, b. i. s.* 356. *Id. Hab. s.* 16.—Lave vitreuse pumice, *Lucas, p.* 231.—Ponce, *Brong. t. i. p.* 332.—Bimstein, *Haus. s.* 88.—Verre fibreux, *Brard, p.* 448.—Bimstein, *Leonhard, Tabel. s.* 15.—Bimstein, *Karst. Tabel. s.* 36.—Pumice, *Kid, App. p.* 35.—Bimstein, *Steffens, b. i. s.* 379. *Id. Hoff. b. ii. s.* 213. *Id. Lenz, b. i. s.* 439. *Id. Haus. Handb. b. ii. s.* 435.—Pumice, *Aikin, p.* 204.

THIS Subspecies is now divided by Karsten and Werner into three kinds: these are, Glassy Pumice, Common Pumice, and Porphyritic Pumice.

First Kind.

Glassy Pumice.

Glasiger Bimstein, *Werner, Karsten, Hoffmann, and Hausmann.*

External Characters.

Its colour is smoke-grey, of different degrees of intensity

sity; also ash-grey, which sometimes inclines to greyish-white.

It occurs vesicular, and capillary in the vesicular cavities.

Internally the principal fracture is glistening and pearly, the cross fracture shining, and nearly vitreous.

The principal fracture is promiscuous fibrous; the cross fracture small and imperfect conchoidal, inclining to uneven.

The fragments are indeterminate angular, and blunt-edged.

It is sometimes translucent, sometimes only translucent on the edges.

It is intermediate between hard and semi-hard.

It is very brittle.

It is rather easily frangible.

It feels very rough, sharp, and meagre.

Specific gravity 0.378 to 1.444, *Hoffmann*.

Geognostic and Geographic Situations.

It occurs in beds, along with common pumice and obsidian, in the Lipari islands, and in the islands of Santorini and Milo, in the Grecian Archipelago.

Observations.

It is distinguished from *Common* and *Porphyritic Pumice*, by its darker colours, vitreous, shining and conchoidal cross fracture, greater translucency, and greater hardness.

*Second Kind.**Common Pumice.*

Gemeiner Bimstein, *Werner, Karsten, Hoffmann, and Haussmann.*

External Characters.

Its colours are almost always white, and principally greyish and yellowish white, which sometimes approach to yellowish grey, ash-grey, and smoke-grey.

It occurs vesicular, and the vesicles are much elongated. In the interior of the vesicles there are capillary fibres.

Internally it is sometimes glistening, sometimes glimmering, and the lustre is pearly.

The principal fracture is more or less perfect fibrous which is curved and parallel; the cross fracture is uneven.

It breaks into blunt-edged fragments, sometimes into splintery fragments.

It is only translucent on the edges.

It is semi-hard, but in a high degree

It is very brittle.

It is rather easily frangible.

It feels meagre and rough.

Specific gravity, 0.914, *Brisson*.—0.752 and 0.770, *Hoffmann*.

Chemical Characters

At a heat varying from 35° to 40° of Wedgwood, it is so much altered, that its fibrous fracture is no longer distinguishable: at 60°, it melts into a grey-coloured slag.

Constituent

Constituent Parts.

Silica,	-	-	77.50
Alumina,	-	-	17.50
Natron and Potash,	-	-	3.00
Iron, mixed with Manganese,	-	-	1.75
			99.75

Klaproth, Beit. b. iii. s. 265.

Gcognostic Situation.

It occurs in beds, along with glassy pumice and obsidian. In the Island of Lipari, according to Spallanzani, there is a whole hill, named Campo Bianco, in which the pumice is distinctly stratified; and in the same island, it also occurs in globular distinct concretions. It occurs in beds between Andernach and Coblenz; and a remarkable bed of this mineral is contained in alluvial land, near Neuwied.

Geographic Situation.

Europe.—It occurs in the Island of Iceland, along with obsidian*; abounds in the Lipari Islands; is found in the Islands of Santorini and Milo, in the Grecian Archipelago; and, as already mentioned, occurs on the banks of the Rhine.

Africa.—Island of Teneriff.

Asia.—Ternate, and the other Molucca Islands.

America.—In Mexico.

Usca.

* Mackenzie's Travels in Iceland.

Uses.

Common pumice is used for polishing glass, soft stones, and metals; also by parchment-makers, curriers, and hat-makers; and hence it forms a considerable article of trade, and is exported from the Lipari Islands in great quantities to the different countries of Europe. It forms a pernicious ingredient in some teeth-powders: sailors in the Mediterranean use it for shaving; and in the East it is an indispensable article in every bath, for the purpose of removing hairs from the body. On account of its porosity, it is used in Teneriff as a filtering-stone. In Italy it is ground down, and used in place of sand in the making of mortar.

Observations.

It is distinguished from *Glassy Pumice* by its lighter colours, the nature of its lustre, its more perfect fibrous fracture, its lower translucency, and inferior hardness.

Third Kind.

Porphyritic Pumice.

Porphyrtiger Bimstein, *Werner*, *Karsten*, and *Hoffmann*.

External Characters.

Its colours are greyish-white, and light ash-grey, and very seldom pale blackish-brown.

It occurs massive, in mountain masses; and internally it is minutely porous.

Internally it is glistening or glimmering, and the lustre is pearly.

The

The fracture is very imperfect curved and parallel fibrous, which sometimes passes into compact, or into splintery and uneven.

The fragments are indeterminate angular and rather blunt-edged.

It is feebly translucent on the edges.

It is semi-hard.

It is very brittle.

It is rather easily frangible; and

Is light.

Specific gravity 1.661, *Hoffmann*.

Geognostic and Geographic Situations.

Porphyritic pumice contains crystals of felspar, quartz, and mica, thus forming a kind of porphyry, which is contained in clay porphyry, and is generally associated with claystone, obsidian, pearstone, and pitchstone-porphyry. It occurs in Hungary at Tokay, Keresztur, and Telkobanya; also in the continuation of this tract at Schemnitz, Glashütte, and Kremnitz. It appears also to be associated with porphyry on the northern acclivity of the Carpathians, as at the Green Lake, above Kasemark. It is said to occur also near Rio Mayo, in the Province of Quito.

GENUS XIV.—BORACITE.

THIS Genus contains but one Species, viz. Hexahedral Boracite.

1. Hexahedral

1. Hexahedral Boracite.

Boracite, *Werner*.Hexaedrischer Boracit, *Mohs*.

Boracit, *Wid.* s. 533. *Id. Kirm.* vol. i. p. 172. *Id. Estner*, b. ii. s. 1061. *Id. Emm.* b. i. s. 509. *Id. Nap.* p. 370. *Id. Broch.* t. i. p. 589. *Id. Haüy*, t. ii. p. 337. *Id. Reuss*, b. ii. 2. s. 372. *Id. Lud.* b. i. s. 160. *Id. Suck.* 1st th. s. 578. *Id. Bert.* s. 137. *Id. Mohs*, b. ii. s. 232.—Magnesie boratée, *Lucas*, p. 20.—Borazit, *Leonhard*, Tabel. s. 41.—Magnesie boratée, *Brong.* t. i. p. 167. *Id. Brard*, p. 68.—Boracit, *Karsten*, Tabel. s. 48. *Id. Haus.* s. 120. *Id. Kid*, vol. i. p. 118.—Magnesie boratée, *Haüy*, Tabl. p. 16.—Borazit, *Lenz*, b. ii. s. 855. *Id. Oken*, b. i. s. 399. *Id. Haus.* b. iii. s. 821. *Id. Hoff.* b. iii. s. 138. *Id. Aikin*, p. 173.

External Characters.

Its colours are greyish and yellowish white, which passes into yellowish-grey, ash-grey, smoke-grey, and pale greenish-grey.

It has been hitherto found only regularly crystallized, and in the following figures :

1. Cube, either perfect or variously truncated on the edges and angles.
2. Tetrahedron, truncated on all the edges, and acuminate on all the angles with three planes, which are set on the lateral planes.
3. Rhomboidal or garnet dodecahedron.

The crystals are singly imbedded, generally small and very small, and seldom middle-sized.

The surface is generally smooth, seldom rough, and hence it is splendid or shining externally.

Internally

Internally it is shining and adamantine.

Sometimes an imperfect fourfold cleavage is to be seen, parallel with the sides of an octahedron.—*Mohs*.

The fracture is imperfect and small conchoidal, sometimes passing into small-grained uneven.

The fragments are indeterminate angular and sharp-edged.

It is translucent, and rarely transparent.

It is as hard as quartz.

It is rather brittle.

It is easily frangible.

Specific gravity, 2.911, *Karsten*.—2.8, 3.0, *Mohs*.

Physical Characters.

It is pyro-electric on all the angles, those that are diagonally opposite, being one positive, and the other negative. This electricity is uncommonly easily excited, even more so than in tourmaline, or indeed in any other mineral with which we are acquainted.

Chemical Characters.

Fusible with ebullition into a yellowish enamel.

Constituent Parts.

	From Luneburg.	From Segeberg.	From Luneburg.
Lime, -	11.00		
Magnesia,	13.50	36.3	16.6
Alumina,	1.00		
Silica, -	2.00		
Oxide of Iron,	0.75		
Boracic Acid,	68.00	63.7	83.4
	<hr/> 96.25	<hr/> 100	<hr/> 100.0
	<i>Westrumb.</i>	<i>Pfaff.</i>	<i>Vauquelin.</i>
			<i>Vauquelin</i>

Vauquelin found no lime in the transparent crystals, but only magnesia: hence he is of opinion, that boracite is a simple borate of magnesia. Nearly the same result was obtained by Pfaff, in his analysis of the boracite of the Segeberg.

Geognostic and Geographic Situations.

This curious mineral has been hitherto found only in the Kalkberg, at Luneberg in Hanover, where it occurs in a particular bed, along with imbedded quartz crystals; and in the same formation, in the Segeberg, near Kiel in Holstein.

Observations.

1. This species is well characterized by its crystallizations, kind of lustre, and electrical properties.

2. Lazius, who first attended to this mineral, named it *Cubic Quartz*: Westrumb found by chemical analysis that it contained boracic acid, and named it *Sedative Spar*; and Werner gave it its present denomination.

3. Fluor-spar is sometimes cut into the form of boracite crystals, and sold as such to the ignorant.

ORDER II.—SPAR.

GENUS I.—PREHNITE.

Prehn Spath, *Mohs*.

THIS Genus contains one Species, viz. Prismatic Prehnite.

1. Prismatic Prehnite.

Prismatischer Prehn Spath, *Mohs*.

Prehnite, *Werner*.

Prehnit, *Wern. Bergm. Journ.* for 1790, b. i. s. 110. *Id. Wid.* s. 357. *Id. Emm.* b. i. s. 192.—Prenite, *Nap.* p. 235.—Prehnite, *Lam.* t. ii. p. 311. *Id. Broch.* t. i. p. 295. *Id. Haüy,* t. iii. p. 167. *Id. Reuss,* b. ii. s. 423. *Id. Lud.* b. i. s. 37. *Id. Suck.* 1st th. s. 414. *Id. Bert.* s. 182. *Id. Mohs,* b. i. s. 358. *Id. Lucas,* p. 69. *Id. Brong.* t. i. p. 376. *Id. Haus.* s. 95. *Id. Brard,* p. 171. *Id. Leonhard,* Tabel. s. 15. *Id. Karsten,* Tabel. s. 30. *Id. Kid,* vol. i. p. 250. *Id. Haüy,* Tabl. p. 50. *Id. Steffens,* b. i. s. 382. *Id. Hoff.* b. ii. s. 220. *Id. Lenz,* b. i. s. 444. *Id. Oken,* b. i. s. 356. *Id. Haus. Handb.* b. ii. s. 559. *Id. Aikin,* p. 216.

THIS Species is divided into two Subspecies, viz. Foliated Prehnite, and Fibrous Prehnite.

*First Subspecies.**Foliated Prehnite.**Blättiger Prehnit, Werner.**External Characters.*

The principal colour is apple-green, from which it passes on the one side to leek-green, mountain-green, greenish-grey, and greenish-white, and on the other into grass-green, yellowish-grey, and yellowish-white.

It occurs massive, and in distinct concretions, which are large, coarse, and fine angulo-granular, and also thick and wedge-shaped prismatic. It is sometimes crystallized.

Its primitive form is an oblique four-sided prism of 103° and 77° , which is often so short as to form an oblique four-sided table, as represented in Fig. 70. Pl. 4*. The following are some of the secondary forms which the species assumes:

1. The oblique four-sided table is sometimes truncated either on all its terminal edges, or only on the acute edges. When the truncations on all the edges increase very much, there is formed
2. An irregular eight-sided table, (Fig. 71. Pl. 4. †.)
When the truncations on the acute edges increase considerably, there is formed
3. An irregular six-sided table, (Fig. 72. Pl. 4.) ‡.
When these truncating planes increase in magnitude

Y 2

* Prehnite rhomboidale, Haily.

† Prehnite octogonale, Haily.

‡ Prehnite hexagonale, Haily.

tude, and when the table at the same time becomes thicker, and the obtuse edges are slightly truncated, there is formed

4. A broad rectangular four-sided prism, rather flatly bevelled on the extremities, in which the bevelling planes are set on the smaller lateral planes, and the edge of the bevelment is slightly truncated.

The crystals are small and very small, seldom middle-sized.

They seldom occur single, being generally aggregated, in such a way as to be attached by their lateral planes; sometimes in tabular and manipular groupes, sometimes in cravat and ruff like groupes. All these groupes occur again in druses.

Externally the crystals are almost always shining.

Internally it is shining, or glistening, and is pearly.

The cleavage is imperfect, with folia in one direction parallel to the base of the prism.

The fracture is fine-grained uneven.

The fragments are intermediate angular, and not very sharp-edged.

It alternates from translucent, through semi-transparent into transparent.

Some varieties are as hard as felspar, others as hard as quartz.

It is rather easily frangible.

Specific gravity, 2.609, 2.696, *Hauy*.—2.924, *Hoffm.*—2.8, 3.0, *Mohs*.

Chemical Characters.

It intumesces before the blowpipe, and melts into a pale, green or yellow, or greenish-black frothy glass, but does not gelatinate with acids.

Physical

Physical Characters.

According to the observations of M. De Dree, it becomes electric by heating.

Constituent Parts.

Prehnite of the Cape.		Prehnite of Dauphiny.		
Silica,	- 43.83	Silica,	- 50.0	Silica, - 48
Alumina,	30.33	Alumina,	20.4	Alumina, 24
Lime,	- 18.33	Magnesia,	0.5	Lime, - 23
Oxide of Iron,	5.66	Lime,	- 23.3	Oxide of Iron, 4
Water,	- 1.83	Oxide of Iron,	4.9	—
	<hr/>	Water,	- 0.9	99
	99.89		<hr/>	
			100	
				<i>Fauvelin.</i>

Fauvelin.

Klaproth, Beobacht.
und Entdeck der
Naturf-Freunde zu
Berlin; b. ii. s. 211.

Hassenfratz, Jour-
nal de Physique,
1780.

Geognostic Situation.

Europe.—It was first found in France in the year 1782, by M. Schreiber, near to Rivoire in Oisans, in a steatitic rock, imbedded in massive hornblende. It is not disseminated through the mass of the rock, but traverses it in the form of cotemporaneous veins, that contain, besides this mineral, also axinite, octahedrite, chlorite, calcareous-spar, and other minerals. In the same country, at St Christophe, it occurs, along with axinite, in cotemporaneous veins that traverse granite. Veins containing foliated prehnite also occur in the Alps of Savoy; in the Saualpe in Carinthia; and at Ratschinkes in the district of Sterzing in the Tyrol. It is said to occur massive in amygdaloid, along with calcareous-spar and chlorite, in the Seiser Alp in the Tyrol; and along with foliated chlorite and

and adularia, in the valley of Fusch in Salzburg. The yellowish-white variety is found in a slaty rock, with acicular epidote, and delicate fibrous asbestos, in Mount Crellitz, near St Sauveur, in the valley of Bareges in the Department of the High Pyrenees *; in the Alp Novarda in Piedmont, where it is accompanied with epidote; also at Fahlun and Arendal in Scandinavia.

Africa.—Beautiful apple-green massive varieties of this mineral are found in mountains in the country of the Namaquas, in the interior of Southern Africa. These mountains are said to be granitic, and to contain, besides veins of prehnite, also much copper-ore.

America.—It occurs in Greenland, accompanied with calcareous-spar, in minute cotemporaneous veins in sienite.

Observations.

1. This mineral is characterised by its colour, crystallization, the peculiar grouping of its crystals, cleavage, lustre, transparency, hardness, and weight.

2. It bears some resemblance to Stilbite and Mesotype, in lustre, fracture, and in the changes it experiences by exposure to the heat of the blowpipe: but it is distinguished from them by its green colour, its crystallization, its greater hardness, and weight, as also by its chemical characters.

3. It has been confounded with Prase, Chrysolite, Chrysoprase, Emerald, and Felspar. It was Werner who in the year 1783 first established it as a particular species, and named it after its discoverer *Prehn*, at that time Governor of

* This variety, from its lightness, was for some time considered as a distinct species, under the name *Koupholite*.

of the Cape of Good Hope. He first brought it from the Cape to Europe.

4. The beautiful white-coloured vases sometimes imported from India, and which are said to be of *Jade*, a substance allied to felspar, are, in Count de Bournon's opinion, of the nature of prehnite.

Second Subspecies.

Fibrous Prehnite.

Fasriger Prehnit, *Werner*.

External Characters.

Its colours are siskin-green, oil-green, asparagus-green, mountain-green, and greenish-white.

It occurs massive, reniform, in straight scopiform and stellular fibrous, and radiated distinct concretions, which are collected into large and coarse angulo-granular concretions; also crystallized in acicular four-sided prisms.

Internally it is glistening, and the lustre is pearly.

It breaks into indeterminate angular and rather sharp-edged fragments; sometimes into splintery and wedge-shaped fragments.

It is translucent.

It is as hard as the foliated subspecies.

It is easily frangible.

Specific gravity, 2.889, *Haily*.—2.856, *Hoffmann*.

Chemical Character.

Before the blowpipe it melts into a vesicular enamel.

Physical

Physical Character.

It becomes electric by heating.

Constituent Parts.

Silica,	-	-	42.50
Alumina,	-	-	28.50
Lime,	-	-	20.40
Natron and Potash,			0.75
Oxide of Iron,	-	-	3.00
Water,	-	-	2.00
			<hr/>
			97.15

Laugier, Annales du Museum, t. xv. p. 205.

Geognostic Situation.

This subspecies appears to be confined to secondary mountains; at least it has hitherto been found only in secondary trap rocks, as basalt, amygdaloid, basaltic-greenstone, and common greenstone. It occurs either in contemporaneous veins, or in amygdaloidal, and other shaped cavities in these trap rocks.

Geographic Situation.

Europe.—In Scotland, it occurs in veins and cavities in trap-rocks near Beith in Ayrshire; Bishoptown in Renfrewshire; also at Hartfield, near Paisley; near Frisky Hall, in Cockney Burn, Old Kilpatrick, and Loch Humphrey in Dunbartonshire; in Salisbury Craig, the Castle Rock, and Arthur Seat near Edinburgh; in Berwickshire; and in the Islands of Mull and Raasay.

It occurs in small veins, along with zeolite and native copper, in amygdaloid, at Reichenbach, in the department
of

of Saar in France; also near Oberstein. At Fassa in the Tyrol, it occurs in amygdaloid along with zeolite.

America.—It is found in greenstone in Connecticut and Massachusetts.

• *Observations.*

1. It is distinguished from *Foliated Prehnite*, by its greenish-yellow colours, external shape, low degree of lustre, and distinct concretions; and we may add to these, its geognostic situation.

2. It resembles *Fibrous* and *Radiated Zeolites* in its concretions, lustre, and easy fusibility; but is distinguished from these minerals by its green colours, and its greater hardness and weight.

GENUS II. DATOLITE*.

Dattel Spath, *Mohs.*

Esmarkite, *Hausmann.*

THIS genus contains one species, viz. Prismatic Datolite.

1. Prismatic Datolite.

Prismatischer Datholit, *Mohs.*

This species is divided into two subspecies, viz. Common Datolite, and Botryoidal Datolite.

First

* The name *Datolite* refers to the granular concretions which this species exhibits in the massive varieties, and was given to it by its discoverer M. Esmark.

First Subspecies.

Common Datolite.

Datholit, *Werner*.

Chaux Datholite, *Brong.* t. ii. p. 397. *Igl. Haus.* s. 123. *Id. Karst.* Tabel. s. 17.—Chaux boratée siliceuse, *Hallé*, Tabl. p. 17.—Datolith, *Lenz*, b. ii. s. 859. *Id. Haus. Handb.* b. iii. s. 865. *Id. Hoff.* b. iii. s. 148. *Id. Aikin*, p. 173.

External Characters.

Its colours are greyish-white, milk-white, greenish-white, greenish-grey, which latter inclines to celandine-green, and rarely to muddy honey-yellow.

It occurs in massive portions, which are divided into large coarse and small granular distinct concretions; and crystallized.

The primitive form is an oblique four-sided prism of $109^{\circ} 28'$, and $70^{\circ} 32'$. The principal secondary forms are the following:

1. Low oblique four-sided prism.

- a.* Perfect, but this is rarely the case.
- b.* The angles on the obtuse edges truncated.
- c.* The angles on the acute edges slightly truncated.
- d.* Truncated on all the angles.
- e.* Bevelled on the acute lateral edges.
- f.* Truncated on the acute lateral edges.

When those truncations on the edges, and on the angles of the obtuse lateral edges increase in magnitude, there is formed,

- 2. A rectangular four-sided prism, flatly acuminated on the extremities, with four planes which are set on the lateral planes.

The

[Subsp. 1. Common Datolite.

The crystals are small and very small, seldom middle-sized, and are aggregated in druses.

Externally it is shining.

Internally it is intermediate between shining and glistening, and the lustre is resinous.

The cleavage is parallel with the lateral planes of the prism, but very imperfect.

The fracture is intermediate between fine-grained uneven and imperfect conchoidal.

The fragments are indeterminate angular, and not particularly sharp-edged.

It is translucent, and sometimes transparent.

It is as hard as apatite, sometimes even harder, but never so hard as felspar.

It is very brittle.

It is difficultly frangible.

Specific gravity, 2.980, *Klaproth*.—2.916, *Ullinger*.—2.878, *Hausmann*.

Chemical Characters.

When exposed to the flame of a candle, it becomes opaque, and may then be easily rubbed down between the fingers. Before the blowpipe, it intumesces into a milk-white coloured mass, and then melts into a globule of a pale rose-colour.

Constituent Parts.

Silica, -	36.50	Silica, -	37.66	Silica, -	31.0
Lime, -	35.50	Lime, -	34.00	Lime, -	28.0
Boracic Acid, -	24.00	Boracic Acid, -	21.67	Boracic Acid, -	31.0
Water, -	4.00	Water, -	5.50	Alumina, -	1.0
Trace of Iron and Manganese.		Loss, -	1.17	Iron, Manganese, and Nickel, -	1.5
			100.00	Water, -	1.4
	100.00				

Klaproth, *Beit.*

b. iv. s. 359.

Vauquelin, in *Lucas's*

Tab. Meth. ii. 71.

100

Esmerald.

Geognostic

Geognostic and Geographic Situations.

It is associated with large foliated granular calcareous-spar, more rarely with violet-blue fluor-spar, quartz, and sometimes with apple-green prehnite, in a bed of magnetic ironstone in gneiss, at the mine of Nodebroe, near Arendal in Norway. It is said also to occur in small veins in greenstone, in the Geisalp in Sonthofen; and in the Syseralp*.

Observations.

1. Datolite is characterised by colour, form, distinct concretions, resinous lustre, translucency, and hardness.

2. It resembles prehnite, but is distinguished from it by resinous lustre, compact fracture, inferior hardness, and not becoming electric by heating.

*Second Subspecies.***Botryoidal Datolite or Botryolite.****Botryolith, *Hausmann*.**

This subspecies is divided into two kinds, viz. Fibrous Botryolite, and Earthy Botryolite.

*First Kind.***Fibrous Botryolite.****Fasriger Botryolith, *Hausmann*.**

Fasriger Botryolith, *Haus.* s. 122.—Chaux boratée silice concretionnée-mamelonée, *Hauy*, Tabl. p. 17.—Fasriger Botryolit, *Lenz*, b. ii. s. 858.—Botryolite, *Aikin*, p. 174.

External

* Mr Heuland informs me, that specimens from the Syser Alp are very rare, and to be found only in old collections.

[Subsp. 2. Botryolite,—1st Kind, Fibrous Botryolite.

External Characters.

Externally it is pearl-grey, and yellowish-grey; internally greyish, milk, and reddish white, which passes into pale rose-red. The colours are in concentric stripes.

It occurs reniform, botryoidal, small globular; in fibrous concretions which are scopiform and stellular; these concretions are again collected into small angulo-granular concretions, which are traversed by very thin curved lamellar concretions.

The surface is granulated or rough, and dull.

Internally it is glimmering and pearly.

The fracture is splintery.

It is translucent on the edges.

It is semihard, approaching to soft.

It is brittle.

Specific gravity 2.885, *Klaproth*.

Chemical Characters.

It intumesces and melts into a white glass before the blowpipe.

Constituent Parts.

Silica,	-	-	36.00
Lime,	-	-	39.50
Boracic Acid,	-	-	13.50
Oxide of Iron,	-	-	1.00
Water,	-	-	6.50
			<hr/>
			96.50

Klaproth, Beit. b. v. s. 125.

Geognostic and Geographic Situations.

It occurs in the Kjenlie mine, near Arendal in Norway, along with common quartz, schorl, calcareous-spar, and iron-pyrites, in a bed of magnetic ironstone, in gneiss.

Observations.

1. It is distinguished by its colours, botryoidal shape, concentric curved lamellar and delicate and stellular fibrous concretions, its pearly lustre, and specific gravity.

2. It was first described by Abildgaard of Copenhagen, under the name *Semi-globulär Zcolite*. Its chemical properties were first noticed by Esmark, who, from the effects produced on it by the blowpipe, conjectured that it contained boracic acid. This conjecture was confirmed by the experiments of Gahn and Hausmann, who discovered, that, like datolite, it contained boracic acid, lime, and silica; and Hausmann, on account of its botryoidal shape, gave it the name it now bears.

*Second Kind.**Earthy Botryolite.**Erdiger Botryolith, Hausmann.*

Erdiger Botryolith, Haus. s. 121. Id. Lenz, b. ii. s. 859.

External Characters.

Its colour is snow-white.

It is small botryoidal.

It is dull.

The fracture is earthy.

Geognostic and Geographic Situation.

It occurs along with the fibrous subspecies.

GENUS III.—ZEOLITE *.

Schaum Spath, *Mohs*.

THIS genus contains the following species, viz. 1. Dodecahedral Zeolite, 2. Hexahedral Zeolite, 3 Rhomboidal Zeolite, 4. Pyramidal Zeolite, 5. Di-prismatic Zeolite, 6. Prismatic Zeolite, 7. Prismatoidal Zeolite, 8. Axifrangible Zeolite †. * Wavellite.

1. Dodecahedral Zeolite, or Leucite †.

Dodecaedricher Schaum Spath, *Mohs*.

Leucit, *Werner*.

Grenat d'un blanc cristallin, et grenat dicolore, *Romé de Lisle*, p. 330.—Grenat d'un blanc mat à 24 facettes, *Born*, t. i. p. 436.—Leuzit, *Wid.* s. 229.—Vesuvian or White Garnet, *Kirw.* vol. i. p. 285.—Leuzit, *Estner*, b. ii. s. 188. *Id. Emm.* b. i. s. 348. *Id. Lam.* t. ii. p. 259. *Id. Broch.* t. i. p. 188.—Amphigene, *Hauy*, t. ii. p. 559.—Leucit, *Reuss*, b. ii. th. i. s. 396. *Id. Lud.* b. i. s. 63. *Id. Suck.* 1r th. s. 202. *Id. Bert.* s. 175. *Id. Mohs*, b. i. s. 74. *Id. Hab.* s. 21.—Amphigene, *Lucas*, s. 47. *Id. Brong.* t. i. p. 364. *Id. Brard*, p. 126. *Id. Kid*, vol. i.

* Zeolite (Prismatic and Prismatoidal Zeolite) was discovered by Cronstedt in the middle of the last century: he published an account of this curious mineral in the Memoirs of the Swedish Academy of Sciences for the year 1756. On account of its intumescing and foaming before the blowpipe, he named it *Zeolith*, from the Greek word ζῆω, to foam. In the present arrangement, it is principally used as a generic name.

† *Mohs* names the eighth species *Axentheilender*, because its principal cleavage is perpendicular to the axis of the crystal; and this term is here translated *axifrangible*, until a more appropriate one shall occur.

‡ *Leucite*, from λευκος, white, and refers to its frequent white colour.

vol. i. p. 254. *Id. Haüy*, Tabl. p. 33.—Leucit, *Steffens*, b. i. s. 80. *Id. Hoff.* b. i. s. 482. *Id. Haus.* Handb. b. ii. s. 588. *Id. Aikin*, p. 195.

External Characters.

Its colour is generally white, and most frequently yellowish-white; sometimes also greyish-white, which passes into ash and smoke grey, and rarely reddish-white.

It seldom occurs massive, and in granular concretions, most frequently in roundish imbedded grains, and crystallized in acute double eight-sided pyramids, in which the lateral planes of the one are set on the lateral planes of the other, and the summits deeply and flatly acuminated by four planes, which are set on the alternate lateral edges*.

The crystals are all around crystallized; generally small, and seldom middle-sized.

The surface of the grains is rough, and dull, or feebly glimmering; that of the crystals is smooth, seldom slightly streaked, in the direction of the diagonal, and glistening. Internally the lustre is shining, approaching to glistening, and is vitreous, inclining to resinous.

Sometimes an imperfect cleavage is to be observed.

The fracture is imperfect and flat conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

It is translucent, semitransparent, and some varieties approach to transparent.

It refracts single.

It is harder than apatite, but not so hard as felspar.

It is brittle.

It

* *Amphigene trapezoidal*, Haüy.—*Romé de Lisle*, c. ii. p. 386. Pl. 4. fig. 110.

It is easily frangible.

Specific gravity, 2.463, *Brisson*.—2.464, *Kirwan*.—2.455 to 2.490, *Klaproth*.—2.461, *Karsten*.

Chemical Characters.

Before the blowpipe it is infusible without addition : with borax it forms a brownish transparent glass. According to Lampadius, when exposed to a stream of oxygen gas, it melts easily into a white transparent glass*.

Constituent Parts

Mean of different analyses.

Silica,	-	54	56
Alumina,		24	20
Potash,		21	20
Lime,			2
Loss,	-	1	2
		<hr/> 100	<hr/> 100
		<i>Klaproth</i>	<i>Vauquelin.</i>

Geognostic Situation.

It occurs principally in secondary trap rocks, and in lavas, and appears to be almost exclusively a production of Italy. It is imbedded in basalt and wacke, and other similar rocks, at Albano, and Frascati, near Rome, and in great abundance in the lavas around Naples. At Monte Somma it occurs included in a rock composed of black mica, felspar, (ice-spar), garnet, vesuvian, and calcareous spar, which is found in loose masses.

Geographic Situation.

Its Italian localities are Pompeij, Ponte Felice near Borghetto, Civita Castellana, Aqua Pendente, Somma, Frascati, and Vesuvius. The supposed leucites of the Pyrenees, Transylvania, Norway, and Peru, do not belong to this species.

Observations.

1. *Distinctive Characters.*—*a.* Between leucite and garnet. The colours of garnet are red or brown; those of leucite white or grey: garnet has a considerable variety of crystallizations; leucite but one form, technically denominated the *leucite figure*: garnet scratches quartz, leucite only apatite. The specific gravity of garnet extends from 3.5 to 4.2; but the specific gravity of leucite does not exceed 2.46. And, lastly, garnet is fusible before the blowpipe, leucite infusible.—*b.* Between leucite and analcime. Analcime has in general an uneven fracture, or distinct cleavage; leucite has a conchoidal fracture, and rarely a cleavage: analcime is softer than leucite; analcime occurs covering the walls of drusy cavities, leucite imbedded; and, lastly, analcime is fusible before the blowpipe, leucite is infusible.

2. It was named by Bergman, White Garnet. Werner named it Leucite, from its white colour; and it was he who first established it as a distinct species.

3. It sometimes weathers to a white earth, in the manner of felspar; a change which is probably owing to the abstraction of its alkali.

4. Von Buch is of opinion that this mineral is an igneous production; whereas Werner, Mohs, &c. view it as an aquatic production.

5. Karsten subdivided it into three subspecies, viz. Conchoidal, Uneven, and Earthy; but these appear to be but varieties produced by the action of volcanic fire.

2. Hexahedra!

2. Hexahedral Zeolite, or Analcime*.

Hexaedrischer Schaum Spath, *Mohs*.

Analcime, *Haüy*.

Kubizit, *Werner*.

Analcime, *Haüy*, t. iii. p. 180. *Id. Mohs*, b. i. s. 385. *Id. Lucas*, p. 71. *Id. Brong.* t. i. p. 380. *Id. Haus.* s. 94. *Id. Brard*, p. 175. *Id. Leonhard*, Tabel. s. 17. *Id. Karsten*, Tabel. s. 30. *Id. Haüy*, Tabl. p. 51. *Id. Steffens*, b. i. s. 401.—Kubizit, *Hoff*, b. ii. s. 251.—Analcim, *Lenz*, b. i. s. 457.—Wurfeliger Cubicit, *Oken*, b. i. s. 349.—Blättricher Analzim, *Haus.* Handb. b. ii. s. 587.—Analcime, *Aikin*, p. 212.

External Characters.

Its colours are greyish and yellowish white, but seldom milk and reddish white, which latter passes into flesh-red.

It seldom occurs massive, and this variety is disposed in coarse and small angulo-granular concretions, which are in general very closely aggregated; generally crystallized, in the following figures:

1. Perfect cube, which is its primitive figure, fig. 78.

Pl. 4. †.

2. The cube flatly and deeply acuminate on all the angles, with three planes, which are set on the lateral planes, fig. 79. Pl. 4. ‡. When the acumi-

Z 2

nating

* The name *Analcime* is derived from the Greek, and signifies a body without power, because this mineral is only feebly electric by friction.

† The primitive figure, according to *Haüy*, is the cube.

‡ *Analcime tripointé*, *Haüy*.

nating planes become larger, and at length all the planes of the primitive figure disappear, there is formed

3. An acute double eight-sided pyramid, deeply and somewhat flatly acuminate on both extremities, with four planes which are set on the alternate lateral edges, fig. 80. Pl. 4. *.

The crystals are small and very small, seldom middle-sized, and rarely large; and they rest on one another, or mutually penetrate each other.

The surface of the crystals is smooth, and splendid or shining.

Internally it is intermediate between shining and glistening, and the lustre is vitreous, inclining to pearly.

The cleavage is threefold, but imperfect; and the folia are parallel with the sides of the cube.

The fracture is small or fine-grained uneven, or conchoidal.

The fragments are generally indeterminate angular, seldom more or less cubical, owing to the imperfection of the cleavage.

It is translucent or semitransparent, and the crystals are transparent.

It is harder than apatite, but softer than felspar.

It is easily frangible.

Specific gravity, 2.244, *Vauquelin*.—2.2, 2.0, *Mohs*.

Chemical Characters.

It melts with intumescence, before the blowpipe, into a transparent glass.

Physical

* *Analcime* trapezoidal, *Hauy*.

Physical Character.

By friction, but not by heating, it becomes electric.

Constituent Parts.

Analcime of Montecchio-Maggiore.

Silica,	-	-	58.0
Alumina,	-	-	18.0
Lime,	-	-	2.0
Natron,	-	-	10.0
Water,	-	-	8.5

96.5

Vauquelin, Annal. du Mus.
d'Hist. Nat. t. ix. p. 241.

Geognostic Situation.

It occurs in primitive and secondary rocks, but more abundantly in secondary than in primitive country. Thus, it sometimes appears along with magnetic ironstone in gneiss, where it is associated with garnet, augite, hornblende, epidote, prehnite, and calcareous-spar: in metalliferous veins that traverse clay-slate, where it is accompanied with galena, ores of silver and zinc, and calcareous-spar and quartz; very frequently in amygdaloid, and also in basalt and clinkstone porphyry, in which it occurs either in contemporaneous veins, or in vesicular cavities.

Geographic Situation.

It occurs in the secondary greenstone of Salisbury Craigs, and in the porphyritic rock of the Calton Hill, near Edinburgh: in the greenstone it is contained in drusy cavities, where it is associated with calcareous-spar and prehnite:

ite; in the porphyry, it is in cavities, and is associated with calcareous-spar. Near the village of Old Kilpatrick in Dunbartonshire, where it also occurs in secondary trap-rocks, it is accompanied with prehnite, needle-zeolite, laumontite, and cross-stone; and prehnite and needle-zeolite occur along with analcime at Bishoptown, in the parish of Erskine in Renfrewshire, and near Beith in Ayrshire. The secondary trap of Perthshire, also of the islands of Mull, Staffa, Canna, and Skye, contain crystals of this mineral. In general, it occurs in this country more frequently in the leucitic, than in any other form.

It occurs not unfrequently in the trap-rocks of Iceland, and in those of the Faroe Islands, and Disco in Greenland; but it is a rare mineral in Norway, having hitherto been found only in metalliferous beds near Arendal; and its localities in the North of Germany, are at Andreasberg in the Hartz, where it occurs very rarely in metalliferous veins that traverse primitive clay-slate, and in Bohemia, where it is an inmate of basalt and porphyry-slate.

It occurs in secondary amygdaloid in the Seiser Alp in the Tyrol; in a similar rock at Montecchio-Maggiore, near Vicenza in Italy; in the Bannat of Temeswar.

This species was first discovered by Dolomieu, who found it in the amygdaloid rocks of Etna in Sicily; and a mineral named by the late Dr Thompson of Naples *Sarcelite*, and considered by Haüy as a variety of analcime, occurs in the rocks of Monte Somma, near Naples.

3. Rhomboidal

3. Rhomboidal Zeolite, or Chabasite*.

Rhomboedrischer Schaum Spath, *Mohs*.

Chabasie, *Haüy*.

Schabasit, *Werner*.

Chabasie, *Haüy*, t. iii. p. 176. *Id. Mohs*, b. i. s. 380. *Id. Lucas*, p. 70. *Id. Brong.* t. i. p. 382. *Id. Leonhard*, Tabel. s. 16.—Chabasin, *Karst.* Tabel. s. 80. *Id. Haus.* s. 95.—Chabasie, *Brard*, p. 174. *Id. Haüy*, Tabl. p. 50.—Chabasin, *Steffens*, b. i. s. 399.—Schabasit, *Hoff.* b. ii. s. 257.—Chabasie *Lenz*, b. i. s. 468.—Rhombodrischer Cubicit, *Oken*, b. i. s. 349.—Chabasin, *Haus.* Handb. b. ii. s. 584.—Chabasie, *Aikin*, p. 210.

External Characters.

Its colour is greyish-white, approaching to yellowish-white.

It seldom occurs massive; almost always crystallized. Its primitive figure is a rhomboid of 93° 36', and 86° 24', represented in fig. 81, Pl. 4. The following are the most frequent secondary forms:

1. Truncated on the six obtuse lateral edges.
2. Truncated on the six obtuse lateral edges, and on the six obtuse angles, fig. 82. Pl. 4. †.
3. In which each of the original planes of the rhomboid is divided into two, fig. 83. Pl. 4. ‡.

The crystals are small, middle-sized, and very small, and superimposed and resting on each other.

The

* The name *Chabasie*, is from Chabazion, a stone described by Orpheus in his poems, but unknown to us at present.

† Chabasie tri-rhomboidal, *Haüy*.

‡ Chabasie disjointe, *Haüy*.

The lateral planes of the crystals are streaked in a peculiar manner: the streaks shoot from the shorter diagonal, (the dividing edge of the plane), and run parallel with the two adjoining lateral edges of the rhomb. The truncating planes are smooth.

Externally the crystals are splendid; internally glistening, and the lustre is vitreous.

The cleavage is three-fold, in the direction of the planes of the rhomboid.

The fracture is imperfect conchoidal, and also small-grained uneven.

The fragments are indeterminate angular.

It is translucent; the crystals sometimes pass into semi-transparent.

It is as hard as fluor-spar, and sometimes even harder, but never so hard as apatite.

It is easily frangible.

Specific gravity, 2.717, *Haüy*.—2.0, 2.1, *Mohs*.

Chemical Character.

Before the blowpipe it melts easily into a spongy white enamel.

Constituent Parts.

Chabasite of the Faroe Islands.

Silica,	-	-	43.33
Alumina,	-	-	22.66
Lime,	-	-	3.34
Natron, with Potash,	-	-	9.34
Water,	-	-	21.00

99.67

Vauquelin, *Annal. de Mus.*

d'Hist. Nat. t. ix. p. 333.

Geognostic

Geognostic Situation.

It occurs principally in secondary trap rocks; most frequently in cavities of amygdaloid, where it is often associated with agate, calcareous-spar, zeolite, and green-earth. It is said also to occur in a clayey rock, which contains mica and garnet, and in small veins in a rock composed of hornblende and felspar: but we are ignorant of the class to which these rocks belong.

Geographic Situation.

Europe.—The vesicular cavities of the trap-rocks of Mull and Skye afford crystals of chabasite: it occurs in similar rocks in the north of Ireland; and beautiful specimens are found in the amygdaloid of Iceland and of the Faroe Islands. The agate-balls imbedded in the amygdaloid of Oberstein on the Rhine, sometimes contain beautiful crystals of this mineral; and the clayey, and felspar and hornblende rocks already mentioned, which occur in the Seiser Alp in the Tyrol, afford fine crystals of chabasite. It is said to occur in the basalt of Saxony.

Africa.—It occurs in the trap-rocks of the Isle of Bourbon.

America.—In secondary trap rocks in North Greenland.

Observations.

1. The principal characters of this species are crystallization, streaking, kind of lustre, fracture, hardness, and weight.

2. It was formerly united with analcime, to which it is so very nearly allied, that it required the sagacity of Haüy and Werner to establish the marks of difference between them.

them. It is distinguished from *Analcime* by its crystallizations, and streaking.

3. In form it is nearly allied both to *Calcareous-spar* and *Axinite*: it is distinguished from *Calcareous-spar* by its form, fracture, and its remaining unaltered in acids; and its inferior hardness at once distinguishes it from *Axinite*.

4. Pyramidal Zeolite, or Cross-Stone.

Pyramidischer Schaum Spath, *Mohs*.

Kreutstein, *Werner*.

Harmotome, *Haüy*.

Hyacinth blanche cruciforme, *Romé de Lisle*, t. ii. p. 299.—*Staurolite*, *Kirw.* vol. i. p. 282. *Id. Estner*, b. ii. s. 499. *Id. Emm.* b. i. s. 209.—*Ercinite*, *Nap.* p. 239.—*Andreolithe*, *Lam.* t. ii. p. 285.—*Harmotome*, *Haüy*, t. iii. p. 191.—*Pierre cruciforme*, *Broch.* t. i. p. 311.—*Kreutzstein*, *Reuss*, b. ii. s. 430. *Id. Lud.* b. i. s. 90. *Id. Suck.* 1st th. s. 418. *Id. Bert.* s. 248. *Id. Mohs*, b. i. s. 382. *Id. Hab.* s. 24.—*Harmotome*, *Lucas*, p. 73.—*Kreutzstein*, *Leonhard*, Tabel. s. 17.—*Harmotome*, *Brong.* t. i. p. 385. *Id. Brard*, p. 178. *Id. Haus.* s. 95.—*Kreutzstein*, *Karst.* Tabel. s. 30.—*Staurolite*, *Kid*, vol. i. p. 251.—*Harmotome*, *Haüy*, Tabl. p. 51.—*Kreutzstein*, *Steffens*, b. i. s. 405. *Id. Hoff.* b. i. s. 261. *Id. Lenz*, b. i. s. 471. *Id. Oken*, b. i. s. 348.—*Harmotom*, *Haus.* Handb. b. ii. s. 557.—*Harmotome*, *Aikin*, p. 208.

External Characters.

Its most frequent colour is greyish-white, seldom yellowish and reddish white: the greyish-white passes into smoke-grey; and the yellowish-white into cream-yellow, brick-red, and flesh-red.

It occurs very rarely massive; most frequently crystallized.

Its primitive form is a double four-sided pyramid of $121^{\circ} 58'$, and $86^{\circ} 36'$. The following are the principal secondary forms which have been observed:

1. Broad, seldom equilateral, rectangular four-sided prism, rather acutely acuminate on the extremities with four planes, which are set on the lateral edges, fig. 84. Pl. 4. *.
2. The preceding figure, in which the edges formed by the meeting of the acuminate planes that rest on the broader lateral planes are truncated, fig. 85. Pl. 4. †. When these acuminate planes become so large that the original acuminate planes almost disappear, then the prism appears bevelled on the terminal planes. Very rarely No. 1. becomes very low, when a figure resembling the rhomboidal dodecahedron is formed.
3. Twin-crystal, which is formed by two crystals of No. 1. intersecting each other, in such a manner that a common axis and acumination is formed, and the broader lateral planes make four re-entering right angles, fig. 86. Pl. 4. ‡.

The crystals are small, middle-sized, and very small, and are singly superimposed.

The surface of the smaller lateral planes is double plumbosely streaked, the broader lateral planes transversely streaked, and the acuminate planes streaked parallel with the smaller lateral planes.

Internally

* Harmotome dodecaedre, Haiiy.

† Harmotome partiel, Haiiy.

‡ Harmotome cruciforme, Haiiy.

Internally it is glistening, and the lustre is intermediate between vitreous and pearly.

It has a cleavage, in which the folia are in three directions, two of them oblique, and one parallel with the axis.

The fracture is small and perfect conchoidal, passing into uneven.

It breaks into indeterminate angular and pretty sharp-edged fragments.

It is translucent, sometimes passing into semitransparent.

It is harder than fluor-spar, but softer than apatite.

It is easily frangible.

Specific gravity, 2.333, *Hall.*—2.3, 2.4. *Mohs.*

Chemical Characters.

Before the blowpipe it exhibits a greenish-yellow phosphorescence, and then melts with intumescence into a colourless glass.

Constituent Parts.

Silica,	47.5	44 to 47	49
Alumina,	19.5	20 to 12	16
Barytes,	16.0	25 to 20	18
Water,	13.5	10 to 16	15
Iron,		4	
	<hr/> 96.5	<hr/> 100 99	<hr/> 98
	<i>Tassaert.</i>	<i>Westrumb.</i>	<i>Klap. Beil.</i>
			b. ii. s. 83.

Geognostic and Geographic Situations.

It has been hitherto found only in mineral veins and in agate balls. At Andreasberg in the Hartz, it occurs in veins

veins that traverse clay-slate and greywacke rocks, along with quartz, calcareous-spar, galena, or lead-glance, copper-pyrites, iron-pyrites, and grey copper-ore; and of all the materials of the veins, it is the uppermost. The mining district of *Kongsberg* in Norway, which is situated in primitive strata of mica-slate and hornblende-slate, is traversed by numerous metalliferous veins, containing native silver, ores of silver, lead, zinc, arsenic, and iron, and vein-stones of calcareous-spar, heavy-spar, common quartz, and rock-crystal, and sometimes of adularia, zeolite, axinite, chlorite, mountain-cork, fluor-spar, schorl, brown-spar, and *cross-stone*. Strontian in Argyleshire is the only other place where it has been observed in veins; and there it occurs in galena veins that traverse gneiss. At Oberstein it occurs in single crystals, along with chabasite, in agate balls, in trap rocks, and in a singular situation near the village of Old Kilpatrick in this country*.

5. Di-prismatic Zeolite, or Laumonite †.

Di-prismatischer Schaum Spath, *Mohs*.

Lomonit, *Werner*.

Zeolithe efflorescente, *Haiiy*, t. iv. p. p. 410.—*Lomonit*, *Haus.* s. 95. *Id. Karsten*, Tabel. s. 32.—*Laumonite*, *Haiiy*, Tabl. p. 49. *Id. Lucas*, t. ii. p. 188. *Id. Steffens*, b. i. s. 409. *Id. Hoff.*

* Dr Thomas Brown of Glasgow.

† This mineral is named *Laumonite*, in compliment to Gillet Laumont.

Hoff, b. ii. s. 267. *Id. Letz*, b. i. s. 470.—*Spathiger Laumonte*, *Oken*, b. i. s. 393.—*Laumonit*, *Haus.* b. ii. s. 555. *Id. Aikin*, p. 210.

External Characters.

Its colours are yellowish-white, snow-white, and greyish-white.

It occurs in massive forms, which are arranged in large and coarse granular distinct concretions : also crystallized.

The primitive figure is a double prism, the one vertical, and the other horizontal. The obtuse angle of the vertical prism is 98° , of the horizontal prism $121^\circ 34'$. It may be described as an oblique four-sided prism, bevelled on the extremities; the bevelling planes set on the obtuser lateral edges. This prism has its lateral edges sometimes rounded off, so that the crystals become reed-like.

The crystals are small, superimposed, and form druses.

Internally it is sometimes shining, sometimes glistening, and the lustre is pearly.

The cleavage is double; and the *folia* are delicately longitudinally streaked.

The fragments are indeterminately angular and blunt-edged.

When in a fresh state it is transparent, but on exposure to the atmosphere, it very soon becomes opaque.

When fresh, it is rather harder than fluor-spar; but on exposure to the atmosphere, it soon becomes so soft as to yield to the mere pressure of the finger.

It is uncommonly easily frangible.

Specific gravity, 2.234, *Bournon*.—2.3, 2.4, *Mohs*.

Chemical Characters.

It forms a jelly with acids. According to Vogel, it dissolves with effervescence in cold muriatic and nitric acids, and the solution immediately forms a transparent jelly: it dissolves in sulphuric acid slightly heated, and forms with it a white-coloured opaque jelly. Before the blowpipe it intumesces, and is changed into a pearly shining compact mass.

Constituent Parts.

Silica,	-	49.0	
Alumina,	-	22.0	
Lime,	- -	9.0	
Water,	- -	17.5	
Carbonic Acid,	-	2.5	
		<hr/>	
		100	Vogel.

Geognostic and Geographic Situations.

Europe.—This mineral was first found, in the year 1785, in the lead-mines of Huelgoet in Brittany, by M. Gillet Laumont, a distinguished French mineralogist. Since that period, it has been discovered in other parts of the world. It is found in secondary trap, along with analcime, needle-zeolite, and cross-stone, near the village of Old Kilpatrick in Dunbartonshire, and in Renfrewshire; in a similar rock in the counties of Fife and Perth; and in the island of Sky. At Portrush in Ireland, it is an inmate of trap-rocks, along with crystals of foliated zeolite and analcime; and in amygdaloid in the Faroe Islands. It has been brought from Dupapiatra, near Zalathna in Transylvania; and it is contained in the amygdaloid of the Vicentine; it likewise accompanies the beautiful apatite of St Gothard.

Asia.

Asia.—It is said to occur in China, along with prehnite.

America.—In greenstone near Newhaven in Connecticut.

Observations.

1. This mineral disintegrates so readily on exposure to the atmosphere, that if we wish to preserve our specimens unaltered, they must be kept in well-closed glass vessels, or their surface must be covered with gum or varnish; and it is said that they will not disintegrate if immersed in distilled water.

3. The most complete and satisfactory account of this mineral hitherto published, is that of Count de Bournon, in the first volume of the Memoirs of the Geological Society.

6. Prismatic Zeolite or Mesotype *.

Prismatischer Schaum Spath, *Mohs*.

Mesotype, *Haily*.

THIS species is divided into three subspecies, viz. Fibrous Zeolite, Natrolite, and Mealy Zeolite.

First Subspecies.

Fibrous Zeolite.

Faseriger Zeolit, *Werner*.

THIS subspecies is divided into two kinds, viz. Acicular or Needle Zeolite, and Common Fibrous Zeolite.

First

* *Mesotype*, from the Greek words *μεσος* and *τυπος*, because its primitive figure is intermediate between those of two other species of this genus, viz. *Analcime* and *Stilbite*.

*First Kind.***Acicular or Needle Zeolite.****Nadelzeolith, Werner.**

Mesotype, *Haüy*, t. iii. p. 151.—Prismatischer Zeolith, *Karst* Tabel. s. 30.—Prismatischer Mesotyp, *Steffens*, b. i. s. 388.—Nadelzeolith, *Hoff*. b. ii. s. 235.—Prismatischer Zeolith, *Lenz*, b. i. s. 455.—Sauliger Mesotyp, *Oken*, b. i. s. 352.—Mesotype, formes determinables, *Haüy*, Tabl. p. 48.—Glasartiger Zeolith, *Haus*. b. ii. s. 564.—Nadelstein, *Aikin*, p. 212.

External Characters.

Its colours are greyish or yellowish white, and frequently reddish-white.

It occurs massive, and in distinct concretions; these are prismatic and granular; the prismatic are thin, sometimes passing into fibrous, straight, and scopiform; the granular include the prismatic, and are large and coarse. It also occurs crystallized. The primitive figure is a prism of $91^{\circ} 25'$, and the following are the secondary figures:

1. Acicular rectangular four-sided prism, very flatly acuminated with four planes, which are set on the lateral planes, fig. 73. Pl. 4.
2. Sometimes two of the acuminating planes disappear, when there is formed an acute bevelment, which is set on somewhat obliquely.
3. The prism is sometimes truncated on the edges, as in fig. 74. Pl. 4. †;

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A a

The

* Mesotype pyramidée, *Haüy*.

† Mesotype dioctaedre of *Haüy*.

The crystals are sometimes scopiformly aggregated, sometimes promiscuously aggregated.

The lateral planes of the crystals are longitudinally streaked, but the acuminate planes are smooth.

Externally the crystals are shining, passing into splendent.

Internally it is glistening, and the lustre is vitreous, inclining to pearly.

The cleavage is twofold, in the direction of the lateral planes of the prism.

The fracture is small and fine-grained uneven.

It breaks into splintery and wedge-shaped fragments.

It is translucent; the crystals are semitransparent and transparent; and it refracts double.

It is as hard as apatite, but not so hard as felspar, *Mohs*.—Scratches calcareous-spar, but not fluor-spar, *Haus*.

It is brittle.

Specific gravity, 2.179, 2.198, 2.270, *Hoffmann*.—2.0, 2.3, *Mohs*.

Chemical Characters.

It intumesces before the blowpipe, and forms a jelly with acids.

Physical Characters.

It becomes electric by heating, and retains this property some time after it has cooled. The free extremity of the crystal, with the acuminations, shews positive, and the attached end negative electricity.—*Haüy*.

Constituent

[Subsp. 1. *Fibrous Zeolite*,—1st Kind, *Acicular* or *Needle Zeolite*.

Constituent Parts.

Silica,	-	50.24	50
Alumina,	-	29.30	20
Lime,	-	9.46	8
Water,	-	10.00	22
		<hr/> 99.00	<hr/> 100

Vauquelin, Jour. des
Mines, N. 44. p. 576.

Pelletier, Mem. de
Chimie, Paris,
1798, t. i. p. 41.

Geognostic and Geographic Situations.

Europe.—It occurs in secondary trap rocks, as in basalt, greenstone, and amygdaloid. In this country it occurs near the village of Old Kilpatrick, Dunbartonshire, also in Ayrshire and Perthshire, and always in trap-rocks. It is found in secondary trap-rocks in the island of Iceland, and in the Faroe Islands; also in the rocks of the Puy de Marman in Auvergne; and in the Tyrol.

America.—It occurs in secondary trap-rocks in the Island of Disco, in West Greenland, and in greenstone rocks in the United States.

Observations.

1. It is distinguished from *Radiated Zeolite* by its crystallization, vitreous lustre, prismatic distinct concretions, greater transparency, hardness, and brittleness: it is distinguished from *Common Fibrous Zeolite* by its more frequent and distinct crystallizations, its higher and more vitreous lustre, its prismatic distinct concretions, greater transparency, hardness, and brittleness.

*Second Kind.***Common Fibrous Zeolite.****Gemeiner Faser Zeolith, Werner.**

Faserzeolith, *Karsten*, Tabel. s. 30.—Fasriger Mesotyp, *Steffens*,
 b. i. s. 387.—Gemeiner Faserzeolith, *Hoff*. b. ii. s. 233.—
 Fasriger Zeolith, *Lenz*, b. i. s. 454.—Fasriger Mesotyp, *Oken*,
 b. i. s. 352.—Fasriger Zeolit, *Haus*. b. ii. s. 567.

External Characters.

Its colours are generally snow-white, greyish-white, or yellowish-white, seldom reddish-white: from reddish-white it passes into flesh-red, and into a colour intermediate between flesh-red and brick-red; and from yellowish-white into a colour intermediate between yellowish-grey and ochre-yellow, and into pale yellowish-brown.

It occurs massive, in blunt-angular pieces, in balls, and small reniform, and these forms are composed of distinct concretions, which are fibrous and granular. The fibrous concretions are thin, straight, scopiform, and stellular; the granular, which include the fibrous, are large and coarse longish or angulo-granular, and are very much grown together.

It also occurs in capillary crystals.

The external surface of the reniform varieties is rough and dull.

Internally it is strongly glimmering, passing into glistening, and the lustre is pearly.

It breaks into splintery or wedge-shaped fragments.

It is faintly translucent.

Its hardness is the same as needle zeolite.

It

[Subsp. 1. *Fibrous Zeolite*,—2d Kind, *Common Fibrous Zeolite*.

It is rather brittle.

It is easily frangible.

Specific gravity 2.158 to 2.197, *Hoffmann*.

Its geognostic and geographic situations are the same with needle zeolite.

Chemical Characters.

It intumesces before the blowpipe, and forms a jelly with acids.

Constituent Parts.

Silica,	-	49.	54.46
Alumina,		27.	19.70
Lime,	-		1.61
Soda,	-	17.	15.09
Water,	.	9.5	9.83
<hr/>			<hr/>
102.5			100.69
<i>Smithson</i> , Phil. Trans.			<i>Gehlen</i> in Schweigger's
1811, p. 171.			Journal, viii. 355.

Observations.

1. It is distinguished from the other kind by its inferior lustre, fibrous concretions, low degree of translucency; and to these we may add its almost total want of regular crystallizations.

2. It is distinguished from *Calc-sinter*, with which it has been confounded, by its distinct concretions, inferior weight, and its not effervescing with acids.

*Second Subspecies.***Natrolite.**Natrolith, *Werner*.

Natrolith, *Reuss*, b. iv. s. 153. *Id. Mohs*, b. i. s. 364. *Id. Brong.* t. i. p. 370. *Id. Brard*, p. 415. *Id. Haus.* s. 96. *Id. Leonhard*, Tabel. s. 15. *Id. Karst.* Tabel. s. 36. *Id. Häuy*, Tabl. p. 64. *Id. Steffens*, b. i. s. 412. *Id. Hoff.* b. ii. s. 273. *Id. Lenz*, b. ii. s. 945. *Id. Oken*, b. i. s. 356. *Id. Haus.* b. ii. s. 570. *Id. Aikin*, p. 212.

External Characters.

Its colour is intermediate between cream-yellow and ochre-yellow, sometimes approaching to pale yellowish-brown, or yellowish-white. The colours are generally arranged in narrow striped delineations, which are parallel with the reniform external shape.

It occurs massive, in plates, and reniform; also in distinct concretions, which are fibrous, granular, and lamellar; the fibrous are straight, and scopiform or stellular; these are collected into large and coarse granular, and both are intersected by curved lamellar concretions.

The surface of the concretions is streaked.

It is seldom regularly crystallized, and the crystals are only acicular and capillary.

Internally it is glistening, passing into glimmering, and the lustre is pearly.

The fracture is not visible.

It breaks in indeterminate angular, and wedge-shaped pieces.

It is translucent on the edges.

It has the same degree of hardness as needle zeolite.

It

It is easily frangible.

Specific gravity 2.200, *Klaproth*.

Chemical Characters.

Before the blowpipe it becomes first black, then red, intumesces, and melts into a white compact glass.

Constituent Parts.

Silica,	-	-	48.00
Alumina,	-		24.25
Natron,	-		16.50
Oxide of Iron,	-		1.75
Water,	-		9.00

99.50

Klaproth, *Beit. b. v. s.* 44.

Geognostic and Geographic Situations.

It occurs in small cotemporaneous veins in clinkstone porphyry, in the hills of Hohentwiel, Stauffen, Hohenkralen, and Magdeberg in Wurtemberg; and at Aussig in Bohemia. In Scotland, in the trap-tuff hill named the Bin, behind Burntisland, and in the trap-rocks of the islands of Mull and Canna.

Observations.

1. The colour, and in particular the circular colour-delineation, the reniform external shape, and the distinct concretions, are the principal characters of this subspecies. It is distinguished from *Fibrous Zeolite*, with which it has been confounded, by its colour, and distinct concretions.

2. It

2. It was first analysed by Klaproth, who gave it its name on account of the great quantity of Natron or mineral alkali which it contains.

Third Subspecies.

Mealy Zeolite.

Mehlzeolith, Werner.

Id. Wid. p. 361.—Zeolite, *Kirw.* vol. i. p. 278.—Mehl Zeolith, *Estner*, b. ii. s. 481. *Id. Emm.* b. i. s. 199.—Zeolite compatta terrea, *Nap.* p. 235.—La Zeolite farineuse, *Broch.* t. i. p. 298. Mehl Zeolith, *Reuss*, b. ii. s. 405. *Id. Mohs*, b. i. s. 370.—Erdiger Zeolith, *Haus.* s. 96. *Id. Leonhard*, Tabel. s. 16.—Mehl Zeolite, *Karsten*, Tabel. s. 30.—Mesotype altérée aspect terreux, *Haüy*, Tabl. p. 48.—Mehliger Mesotype, *Steffens*, b. i. s. 391.—Mehl Zeolith, *Hoff.* b. ii. s. 232. *Id. Lenz*, b. i. s. 451.—Mehlriger Mesotype, *Oken*, b. i. s. 352.—Mehliger Zeolith, *Haus.* b. ii. s. 568.—Pulverulent Mesotype, *Aikin*, p. 212.

External Characters.

Its colours are yellowish-white, greyish-white, and reddish-white; the latter sometimes passes to pale flesh-red, and even approaches to brick-red.

It occurs massive, reniform, coralloidal, and sometimes it forms a crust over the other subspecies of zeolite.

It is sometimes disposed in delicate fibrous concretions.

Internally it is dull, or very feebly glimmering.

The fracture is coarse earthy.

The fragments are indeterminate angular, and blunt-edged.

It is opaque.

The

The mass is very soft, but the individual parts as hard as fibrous zeolite.

It is rather sectile.

It is uncommonly easily frangible.

It does not adhere to the tongue.

It feels rough and meagre; and when we draw our finger across it, it emits a grating sound.

It is sometimes so light as nearly to swim in water.

Chemical Characters.

It intumesces before the blowpipe, and forms a jelly with acids.

Constituent Parts.

Silica,	-	60.0
Alumina,	-	15.6
Lime,	-	8.0
Oxide of Iron,	-	1.8
Loss, by exposure to heat,		11.6

97

Hisinger's Afhandlingar i Fysik, &c. th. 3.

Geognostic Situation.

It occurs in similar repositories with the other sub-species.

Geographic Situation.

It is found near Tantallon Castle in East Lothian, in the islands of Sky, Mull, and Canna, also in the Faroe islands, Iceland, and Sweden.

7. Prismatoidal Zeolite or Stilbite*.

Prismatoidescher Schaumspath, *Mohs.*

Stilbite, *Häuy.*

THIS Species is divided into two Subspecies, viz. Foliated Zeolite, and Radiated Zeolite.

First Subspecies.

Foliated Zeolite.

Blätter-Zeolith, *Werner.*

Gemeiner Zeolith, *Wid.* p. 363.—Zeolith, *Kirw.* vol. i. p. 278.—Blättriger Zeolith, *Emm.* b. i. s. 204.—Zeolite commune, *Nap.* p. 228.—Zeolite nacrée, *Lam.* t. ii. p. 305.—Zeolite lamelleuse, *Broch.* t. i. p. 302.—Stilbite, *Häuy.* t. iii. p. 161.—Blättriger Zeolith, *Mohs.* b. i. s. 374.—Stilbite, *Brong.* t. i. p. 375.—Stilbit, *Haus.* s. 96.—Blättriger Zeolith, *Leonhard,* Tabel. s. 16.—Stilbit, *Karsten,* Tabel. s. 30.—Stilbit, *Steffens,* b. i. s. 393.—Blätterzeolith, *Hoff.* b. ii. s. 240.—Stilbit, *Lenz,* b. i. s. 465. *Id. Oken,* b. i. 353.—Blättricher Stilbite, *Haus.* b. ii. s. 573.—Stilbite, *Aikin,* p. 209.

External Characters.

Its colours are yellowish and greyish white, seldom milk, snow, and reddish white; from reddish-white it passes into flesh-red and brick-red, even into blood-red. It occurs also yellowish-grey and pinchbeck-brown.

It occurs massive, disseminated, globular, in amygdaloidal-shaped pieces; also in distinct concretions, which are large, coarse, and small angulo-granular; seldom thin and curved

* *Stilbite*, from the Greek word *στילβω*, on accounts of its shining lustre.

curved lamellar *, which are again collected into granular. It is frequently crystallized. The primitive figure is a prism of $99^{\circ} 22'$, of which the following secondary forms occur :

1. Low, oblique, sometimes rather broad, four-sided prism.

a. Truncated on the acute lateral edges.

b. Also truncated on the angles of the obtuse lateral edges †. Fig. 76. Pl. 4.

c. Truncated on all the angles ‡. Fig. 77. Pl. 4.

When the truncating planes of the acuter lateral edges increase, there is formed a

2. Low equiangular six-sided prism, which is

a. Perfect.

b. Slightly truncated on all the angles.

3. Sometimes all the edges of the four-sided prism are truncated, and then an

4. Eight-sided prism is formed.

The crystals are middle-sized, small, and very small.

The lateral planes of the prisms are transversely streaked, the terminal planes are smooth.

The planes are sometimes shining, sometimes splendid, and the lustre is vitreous.

Internally it alternates from shining to splendid, and the lustre is pearly : the pinchbeck-brown has a semi-metallic lustre.

The cleavage is single, perfect, and slightly curved; in the four-sided prism is parallel with the terminal planes, and is parallel with corresponding planes in the other crystallizations.

The

* The lamellar varieties resemble straight lamellar heavy-spar.

† Stilbite anamorphique, Haiiy.

‡ Stilbite octoduodecimale, Haiiy.

The fracture is conchoidal.

The fragments are indeterminate angular and blunt-edged, and sometimes tabular.

The massive varieties are strongly translucent: some varieties, particularly the pinchbeck-brown, are only translucent on the edges; but the crystals are generally semi-transparent and transparent. It refracts single.

It is as hard as calcareous-spar, but seldom as hard as fluor-spar.

It is brittle.

It is easy frangible.

Specific gravity, 2.200, *Hoffmann*.—2. 2.2, *Mohs*.

Chemical Characters.

It intumesces and melts before the blowpipe, and during its intumescence emits a phosphoric light. It does not form a jelly with acids.

Constituent Parts.

Silica,	-	58.3	52.6
Alumina,	-	17.5	17.5
Lime,	- -	6.6	9.0
Water,	-	17.5	18.5
		<hr/>	<hr/>
		100	97.0

Meyer, in *Beschäftigungen der Berl. Vanquelin*, *Jour. de*
Gesellschaft. Naturf-Freunde, *Minas*, N. xxxix.
 b. ii. 1776, s. 475. p. 164.

Geognostic Situation.

It occurs principally in secondary amygdaloid, either in drusy cavities, along with calcareous-spar and calcedony, or in cotemporaneous veins. It is also met with in primitive

tive and transition mountains; there it occurs in metalliferous veins that traverse grey-wacke, as at Andreasberg in the Hartz, where the rectangular four-sided prism is associated with galena; in metalliferous primitive beds at Arendal in Norway, where it is accompanied with magnetic ironstone, quartz, hornblende, epidote, and augite; at Kongsberg in Norway, where it occurs in metalliferous veins that traverse mica-slate and hornblende-slate; and in primitive rocks in Dauphiny*.

Geographic Situation.

Europe.—In Scotland it occurs in drusy cavities or veins in the secondary trap-rocks that abound in the middle division of the country. Very beautiful specimens of the red foliated and radiated zeolites are found at Carbeth in Stirlingshire, and at Loch Humphrey in Dunbartonshire; and the same varieties occur on the coast between Bervie and Stonehaven in Angusshire; also in the secondary trap-rocks of the Hebrides, as of Canna, Skye, and Mull. In the north of Ireland it is an inmate of secondary trap-rocks. It abounds in the trap-rocks of the Faroe Islands, and of Iceland; but it is a rare mineral in the Scandinavian Peninsula. It is found in the trap-rocks of Hessa; in those of Bohemia, of Auvergne, &c.

America.—It occurs in the trap-rocks of Disco in West Greenland; and in those of Zimapan in Mexico.

Asia.—Count de Bournon mentions specimens of this mineral from Kergulen's Island, or the Island of Desolation, which are in his valuable collection †.

Second

* Lord Webb Seymour found this mineral in drusy cavities in the granite at Garbh choiré du, in the Island of Arran.

† Catalogue de la Collection Mineralogique du Comte de Bournon, p. 101.

*Second Subspecies.***Radiated Zeolite.****Strahl Zeolith, Werner.**

Id. Wid. p. 363. *Id. Emm.* b. i. s. 202.—Zeolite commune, *Nap.* p. 228.—Zeolite, first variety, *Lam.* t. ii. p. 305.—Zeolithe rayonnée, *Broch.* t. i. p. 301.—Stilbite, *Haüy*, t. iii. p. 161.—Strahl Zeolith, *Mohs*, b. i. s. 372.—Stilbite, *Brong.* t. i. p. 375.—Stilbit, *Haus.* s. 96.—Strahliger Zeolith, *Leonhard*, Tabel. s. 16.—Stilbit, *Karsten*, Tabel. s. 30.—Zeolith, *Steffens*, b. i. s. 393.—Strahlzeolith, *Hoff.* b. ii. s. 237.—Stilbit, *Lenz*, b. i. s. 465. *Id. Oken*, b. i. s. 353.—Blättrich-strahliger Stilbit, *Haus.* Handb. b. ii. s. 575.

External Characters.

It occurs almost always yellowish-white and greyish-white, seldom snow-white and reddish-white. The yellowish-white passes into yellowish-grey, into a colour intermediate between ochre and lemon yellow, and into yellowish-brown; and the reddish-white into flesh-red, which sometimes borders on blood-red. The greyish-white sometimes nearly passes into smoke-grey.

It is found massive, in angular pieces, and globular; also in distinct concretions, which are prismatic and granular; the prismatic are broad and narrow scopiform, and stellular, and are collected into large, coarse, and small angulo-granular concretions.

It is frequently crystallized. The primitive figure is the same as that of foliated zeolite; and it exhibits the following secondary forms:

1. Broad rectangular four-sided prism, rather acutely acuminate on both extremities by four planes, which

which are set on the lateral edges, as in Fig. 75. Pl. 4. *.

2. The summits of the acuminations are sometimes more or less deeply truncated †. When very deeply truncated, the truncating plane passes into a terminal plane, and the acuminating planes form only truncations on the angles.
3. Sometimes No 1. is so thin, that it may be considered as a long six-sided table, bevelled on the shorter terminal planes ‡.

The crystals are sometimes manipularly and scopiformly aggregated, and frequently so grown together that the acuminations only are visible, and project like pyramids.

The crystals are middle-sized, and small.

The broader lateral planes of the crystals are smooth, the smaller longitudinally streaked, and the acuminating planes are smooth, or rough.

The surfaces of the broader lateral planes of the crystals Nos. 1, 2. are splendent and pearly; the other planes are shining and vitreous: internally, the lustre is more or less shining, and is pearly.

The fragments are wedge-shaped or splintery.

The crystals are strongly translucent, sometimes passing into semi-transparent.

Hardness same as foliated zeolite.

It is brittle.

It is easily frangible.

Specific gravity, 2.132, 2.136, 2.164, *Hoffmann.*

Chemical

* Stilbite dodecaedre of Haüy.

† Stilbite épointée of Haüy.

‡ Stilbite dodecaedre lamelliforme, Haüy.

Chemical Characters.

Same as foliated zeolite.

Constituent Parts.

Silica,	-	-	40.98
Alumina,	-	-	39.09
Lime,	-	-	10.95
Water,	-	-	16.50
			<hr/>
			99.52

Meyer, in Beschäftigungen der Berl. Gessellschaft Naturf-Freunde, b. ii. s. 475.

Its Geognostic and Geographic Situations are the same as those of Foliated Zeolite.

Observations.

1. Crystallization, lustre, fracture, degree of transparency, and distinct concretions, are the characteristic marks of this mineral.

2. It is distinguished from *Needle Zeolite*, by its crystallizations, pearly lustre, broad prismatic concretions.

3. It is distinguished from *Foliated Zeolite* by its crystallizations, and broad prismatic concretions.

8. Axifrangible Zeolite or Apophyllite.

Fischaugenstein, *Werner*.

Apophyllite, *Häuy*.

Ichthyophthalm, *Karsten*.

Zeolith von Hallesta, *Rieman*, Vetensk. Acad. Handl. 1784.—

Zeolithus lamellaris, *Retzius*, Spec. Acad. de Zeolithis Suecicis,

cicis, auct. Müller, Lundæ, 1791, 4to, N. 12.—Apophyllite, Lucas, p. 266. *Id.* Brard, p. 137. *Id.* Haüy, Tabl. p. 36. *Id.* Hausmann, in Weber's Beiträge, b. ii. s. 59. *Id.* Steffens, b. i. s. 479.—Ichthyophthalm, Hoff. b. ii. s. 357. *Id.* Lenz, b. i. s. 528.—Kalkzeolith, Oken, b. i. s. 354. *Id.* Haus. b. ii. s. 581.—Ichthyophthalmite, Aikin, p. 213.

External Characters.

Its principal colour is greyish-white, which passes into greenish-white, seldom into yellowish or reddish white. The ends of the crystals are sometimes asparagus-green; and the same colour is to be observed in patches or spots throughout the crystals. The surface of the cleavage is strongly iridescent.

It occurs massive, and disseminated; the massive varieties are composed of straight and curved lamellar distinct concretions, with feebly streaked splendid pearly surfaces. It is frequently crystallized. The primitive figure is a pyramid, the angles of which are still undetermined. The following are the secondary forms:

1. Rectangular four-sided prism, which is sometimes so low as to appear tabular, and resemble a cube.
2. The preceding figure truncated on all the angles: when the truncating planes become so large that they touch each other, the prism appears acuminate with four planes, which are set on the lateral edges, and the apex of the acuminations truncated*.
3. The rectangular four-sided prism, in which all the lateral edges are truncated, thus forming an eight-sided prism; sometimes the eight solid angles of this figure are truncated.

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* Mesotype épointée, Haüy.

4. The rectangular four-sided prism bevelled on all the edges, or only on some of them : sometimes one of the beveling planes is wanting, when the edge appears to be only obliquely truncated.
5. Slightly oblique four-sided prism. It is formed when the truncating planes of No. 3. become so large that the original planes disappear.
6. Rectangular four-sided prism, in which the angles are truncated, and the edges bevelled.
7. Rectangular four-sided table, in which the two opposite broader terminal planes are doubly bevelled, and the two smaller planes very flatly acuminate with four planes, of which two are set on the lateral planes, and the other two on the terminal planes, and the terminal edges bevelled.

The crystals are very small, small, middle-sized, and very rarely large.

The surface of the crystals Nos. 1, 2. and 4. is smooth ; the surface of Nos. 3. and 5. and the acuminate planes of No. 7. are longitudinally furrowed ; the beveling planes of Nos. 4. 6. and 7. are transversely streaked. All the other planes of the secondary crystals are smooth.

The middle point of the end of the crystals is often concave. The lateral planes occasionally bulging, and the terminal planes rose-like.

Externally it is splendid ; but only the terminal planes of the prism are pearly.

It has a threefold cleavage : two of the cleavages are parallel with the lateral planes, and one with the terminal planes of a four-sided prism. Traces of other indistinct cleavages are visible : the most distinct cleavage is that parallel with the terminal planes, and which is splendid and pearly.

The

The fracture is small and perfect conchoidal, and the lustre is glistening and vitreous.

The fragments are tabular, and rather blunt-edged.

It is semitransparent, passing into transparent, and into translucent. It refracts single.

It is harder than fluor-spar, and sometimes as hard as apatite. When rubbed against a hard body, it splits like selenite into folia.

It is brittle, and very easily frangible.

Specific gravity, 2.417, *Riemann*.—2.467, *Hauy*.—2.430, *Rose*.—2.491, *Karsten*.—2.3, 2.5, *Mohs*.

Chemical Characters.

It exfoliates very readily before the blowpipe, (it even exfoliates when held in the flame of a candle), and melts easily into a white-coloured enamel. It phosphoresces during fusion. When thrown into acids, it exfoliates, and the folia speedily divide into smaller flocculi. When pulverized, and thrown into acids, it gelatinates in the same manner as fibrous zeolite.

Physical Characters.

It becomes feebly electric by rubbing.

Constituent Parts.

Apophyllite of Hällestad.				Apophyllite of Utön.	
Silica,	-	-	55.0	50.0	52.00
Alumina,	-	-	2.3		
Magnesia,	-	-	0.5		
Lime,	-	-	24.7	28.6	21.50
Potash,	-	-	0.0	4.0	8.10
Water,	-	-	17.0	17.0	15.00
			99.5	99.0	99.60
			<i>Riemann.</i>	<i>Vauquelin.</i>	<i>Rose.</i>
			B b 2		Rc

Rose found the water of the apophyllite to contain a small portion of ammonia; so that the volatile alkali appears, like potash and soda, to form a constituent part of some earthy minerals.

Geognostic and Geographic Situations.

It occurs in the secondary trap-rocks of the island of Sky: in rocks of the same description in the Faroe islands; in the island of Disco in West Greenland, and on the mainland of Greenland. One of the earliest known localities of this mineral is the Island of Utön, not far from Stockholm, where it occurs in beds of magnetic-ironstone, along with common felspar, calcareous-spar, and hornblende. It is found also in the great copper-mine of Fahlun; in the mine of Langsoe, at Arendal in Norway; and in ironstone beds at Hällestad in East Gothland; and it has been found in the Tyrol, and at Aussee in Bohemia.

Observations.

1. It is distinguished from Foliated Zeolite by its more perfect pearly lustre, distinct transverse cleavage, iridescence of its cleavage, concavity of the middle of the crystals, and greater hardness.

2. The mineral lately described by Werner, under the name *Albin*, is a variety of this species.

3. The Portuguese mineralogist D'Andrada, several years ago, described a mineral under the name *Ichthyophthalmus*, which appears to be curved foliated pearly felspar. It is therefore a very different mineral from the present species. The name *Ichthyophthalmus*, given to this species by Werner, is derived from the Greek words *ἰχθυς* fish, and *ὀφθαλμος* eye, and was given to it on account of the resemblance of its pearly lustre to that of the eye of a fish.

fish. Haüy names it *Apophyllite*, from its great tendency to exfoliate.

Wavellite (^a).

Hydrargyllite, *Davy*, Nicholson's Journ. xi. p. 153.—*Gregor*, *Id.* xiii. p. 247.—*Wavelit*, *Karsten & Klaproth*, in *Magazin der Gesellschaft Naturf. Freunde zu Berlin*, b. ii. s. 2. *Id.* *Karsten*, *Tabel.* s. 48. *Id.* *Kid*, vol. i. p. 136. *Id.* *Haus.* s. 85.—*Wavellite*, *Lucas*, t. ii. p. 240. *Id.* *Brong.* t. i. p. 434. *Id.* *Aikin*, p. 237. *Id.* *Hoff.* b. iv. s. 148.

External Characters.

Its colours are greyish-white, greenish-white, ash-grey, asparagus-green, and sometimes is spotted-brown.

It occurs botryoidal, globular, stalactitic; and these forms are composed of fibrous or fine prismatic distinct concretions, which are scopiform or stellular; sometimes these prismatic concretions are collected into granular, and both are occasionally traversed by lamellar concretions.

It occurs crystallized, in the following figures:

1. Very oblique four-sided prism, flatly bevelled on the extremities, the bevelling planes set on the obtuse lateral edges.
2. The preceding figure, very deeply truncated on the obtuse lateral edges.

Externally it is shining: internally shining, passing into splendid; and the lustre is pearly.

The fragments are wedge-shaped.

It is translucent.

It is as hard as fluor-spar.

It

(^a) I have not ventured to include Wavellite in the genus *Zeerite* as it is now constructed, but place it apart, and immediately following it, on account of its affinity with the species of the genus.

It is brittle.

Specific gravity, 2.270, *Lucas*.—2.22, 2.253, *Gregor*.—2.25, 2.4, *Aitken*.—2.7, *Davy*.—2.80, *Breithaupt*. The specific gravities of *Davy* and *Breithaupt* appear to be too high.

Chemical Characters.

It becomes opaque and soft by the action of the blow-pipe, but neither decrepitates nor fuses. By the aid of heat it is soluble in the mineral acids and fixed alkalis, with effervescence, and leaves very little residue

Constituent Parts.

	Barnstaple Wavellite.		Cornish Wavellite.	Hualgayoc Wavellite.
Alumina,	71.50	70.0	55.76	68.00
Oxide of Iron,	0.50		0.19	1.00
Lime, -	-	1.4	0.37	
Silica, -	-		6.12	4.50
Water, -	23.0	26.2	30.75	26.50
Loss, -	-	-	3.87	
	100	97.6	100	100
	<i>Klap. Beit.</i>	<i>Davy, Nichol.</i>	<i>Gregor.</i>	<i>Klap Beit.</i>
	b iv. s. 110.	<i>Journ. xii. 157.</i>		b. v. s. 111.

It is said also to contain a small portion of Fluoric Acid.

Geognostic and Geographic Situations.

This mineral occurs in veins, along with fluor spar, quartz, tinstone, and copper-pyrites, in granite, at St Austle in Cornwall. At Barnstaple in Devonshire, where it was first found by Dr Wavell, it traverses slate-clay in the form of small contemporaneous veins*. The Secretary of the Wernerian Society, Mr Neill, found it in a similar situation

* I satisfied myself of the true nature of these veins, by the examination of a beautiful and interesting collection of this mineral, which I owe to the collection of Dr Wavell.

tion in Corrivellan, one of the Shiant Isles, in the Hebrides. Dr Fitton informs us, that it has been found at Spring Hill, about ten miles south-eastward from the city of Cork; and Captain Laskey collected specimens of it from rocks of slate-clay near Loch Humphry in Dunbartonshire. It occurs, along with chabasite, at Fassa in the Tyrol; also in Bohemia, and at Amberg in Bavaria; Sir C. Giesecké met with it in Greenland. Humboldt brought specimens of it from the mines of Hualgayoc in South America, where it is associated with grey copper-ore; and Mr Mawe found it in Brazil.

Observations.

This beautiful mineral was found many years ago by Dr Wavell in a quarry near Barnstaple in Devonshire. Dr Babington examined it, and from its characters concluded that it was a particular species, to which he gave the name *Wavellite*, from the discoverer.

GENUS IV. AZURE-SPAR.

Lazur Spath, *Mohs.*

THIS genus contains four species, viz. Prismatic Azure-Spar, Prismatoidal Azure-Spar, Azurestone, and Calaitc.

1. Prismatic Azure-Spar.

Prismatischer Lazur Spath, *Mohs.*

This species contains two subspecies, viz. *Azurite* and *Haüyne*.

First Subspecies.

Azurite.

Lazulit, *Werner*.

Le Lazulithe, *Broch.* t. i. p. 315. *Id. Haüy*, t. iii. p. 145—Un-
 achter Lazurstein, *Reuss*, b. ii. s. 440.—Lazulit, *Lud.* b. i.
 s. 86. *Id. Suck.* 1^r th. s. 319. *Id. Bert.* b. i. s. 263. *Id. Mohs*,
 b. i. s. 185. *Id. Lucas*, 277.—Lazulite de Klaproth, *Brong.*
 t. i. p. 369.—Gemeiner Lazulit, *Karst.* Tabel. s. 46.—Siderite,
Bernhardi, Jour. fur Chem. p. 204.—Lazulit de Verner, *Haüy*,
 Tabl. p. 62.—Lazulith, *Steffens*, b. i. s. 418. *Id. Hoff.* b. ii.
 s. 285.—Gemeiner Lazulit, *Lenz*, b. i. s. 481. *Id. Oken*, b. i.
 s. 336.—Korniger Lazulith, *Haus.* Hand. b. ii. s. 372.

External Characters.

The most frequent colour of this mineral is indigo-blue,
 which sometimes inclines to sky-blue, sometimes to smalt-
 blue,

It occurs in small massive portions, disseminated, and
 crystallized in very oblique four-sided prisms, which are ra-
 ther flatly acuminate on the extremities, with four planes,
 which are set on the lateral edges.

The cleavage is very perfect, and in the direction of the
 lateral planes of the prism. Its lustre is shining and vi-
 treous.

The fracture is glistening, and the lustre vitreous.

The fracture is small, and fine-grained uneven.

The fragments are indeterminate angular, and rather
 sharp-edged.

It is opaque, or very feebly translucent on the edges.

It is harder than apatite, but not so hard as felspar.

[Subsp. 1. *Azurite*.

It is easily frangible,
Specific gravity unknown.

Chemical Characters.

It is infusible without addition before the blowpipe ; but with borax, it forms a clear pale wine-yellow vitreous bead.

Constituent Parts.

Alumina,	-	-	66
Silica,	-	-	10
Magnesia,	-	-	18
Lime,	-	-	2
Oxide of Iron,	-	-	2½

98½ *Tromsdorf*.

Geognostic Situation.

It occurs imbedded in small portions in quartz ; also in fissures in clay-slate, along with sparry-ironstone, heavy-spar, and quartz.

Geographic Situation.

It occurs principally in the district of Vorau in Stiria ; also in the neighbourhood of Wienerisch-Neustadt in Austria, and near Schwatz in the Tyrol. In all these places it is imbedded in quartz. It occurs in clay-slate in the Pinzgau, and near Werfen in Salzburg.

Observations.

1. The cleavage distinguishes it from *Azurestone*.
2. It is named *Azurite*, from its resemblance to azure-stone in general appearance.

Second

Second Subspecies.

Häüyne.

Häüyn, *Karsten*.

Latialite, *Gismondi & Häüy*, Tabl. p. 62.—*Saphirin*, *Nose*, in *Mineral Studien*, p. 162.—Häüyn, *Steffens*, b. i. s. 416. *Id. Lenz*, b. i. s. 479. *Id. Oken*, b. i. s. 355. *Id. Haus.* b. ii. s. 545. *Id. Hoff.* b. iv. s. 204.

External Characters.

Its colours are pale indigo and Berlin blue, smalt-blue, sky-blue, and bluish-grey.

It occurs in imbedded grains; and rarely crystallized.

1. In acute oblique double four-sided pyramids, in which the lateral planes of the one are set on the lateral planes of the other.
2. Preceding figure truncated on the apices.
3. Preceding figure, in which the acute angles of the common basis are truncated. When the eight planes of the pyramid, the two truncating planes of its apices, and those of the acute angles on the basis, become nearly of equal magnitude, the figure has somewhat the appearance of a rhomboidal dodecahedron, although it belongs to the prismatic, not to the tessular system of crystallization.

The crystals are small, and very small, imbedded, or in very small druses.

Externally it is generally smooth, and sometimes rent, and edges rounded.

Externally and internally it alternates from splendent to glistening, and the lustre is vitreous.

It

It has quintuple cleavage: Of these the most distinct is that parallel with the truncating planes of the apices of the pyramids; the other four cleavages are parallel with the planes of the pyramid.

The fracture is imperfect conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

It is transparent and translucent.

It is harder than apatite, but softer than felspar.

It is brittle.

It is very easily frangible.

Specific gravity, 2.687, *Gmelin*.—3.100? *Neergaard*.

Chemical Characters.

It melts with difficulty before the blowpipe, into a white nearly opaque vesicular bead. With borax it melts into a transparent wine-yellow glass. With acids it forms a translucent jelly.

Constituent Parts.

Silica,	-	-	30.0	35.48
Alumina,	-	-	15.0	18.87
Lime,	-	-	13.5	11.79
Sulphuric Acid,	-	-	12.0	12.60
Potash,	-	-	11.0	15.45
Iron,	-	-	1.0	1.16
Trace of Sulphureted Hydrogen, and loss,	-	-		3.45
Loss,	-	-	17.5	

100

Vauquelin in *Haüy's* *Gmelin*, in *Annals of*
Tabl. Comp. *of Philos.* iv. 198.

Geognostic

Geognostic and Geographic Situations.

It occurs imbedded in the basalt rocks of Albano and Frascati, along with mica, augite, leucite, and vesuvian; also in the basalt of Andernach.

Observations.

1. It was first discovered by the Abbé Gismondi, who named it *Latialite*, from Latium, the ancient name of the country where it occurs: the German mineralogist Nose, who observed it in the trap-rocks of Andernach, considered it as allied to Sapphire, and has described it under the name *Saphirin*: Ferber names it *Blue-schorl* of Andernach: Cordier arranged it with Spinel: Bruun Neergaard, who has given the fullest account of it, has placed it in the system under the name *Haiiyne*; and Steffens, in his System of Mineralogy, places it between Azurestone and Azurite.

2. It is very nearly allied to Azurestone, and probably they may prove to be but varieties of the same species.

2. Prismatic Azure-Spar, or Blue Spar.

Prismatoidischer Lazur Spath, *Mohs*.

Blauspath, *Werner*.

Id. Wid. Bergm. Journ. 1791, p. 345.—Felsite, *Kirr.* vol. i. p. 326.—Dichter Feldspath, *Emm.* b. i. s. 271.—Le Feldspath compacte, *Broch.* t. i. p. 367.—Feld-spath bleu? *Haiiy*, t. ii. p. 605.—Dichter Feldspath, *Reuss*, b. ii. s. 46. *Id. Lud* b. i. s. 100.

s. 100. *Id. Suck.* 1, th: s. 420. *Id. Bert.* s. 238. *Id. Mohs,* b. i. s. 420. *Id. Leonhard,* Tabel. s. 19.—Feldspath Bleu, *Brong.* t. i. p. 360.—Splitteriger Lazulit, *Karsten,* Tabel. s. 46.—Blue Feldspar, *Kid,* vol. i. p. 160.—Feldspath Bleu, *Hauy,* Tabl. p. 60.—Blauspath, *Steffens,* b. i. s. 420. *Id. Hoff.* b. ii. a. 287. *Id. Lenz,* b. i. s. 479. *Id. Oken,* b. i. s. 337.—Splittriger Hartstein, *Haus. Handb.* b. ii. s. 373.—Blue Feldspar, *Aikin,* p. 188.

External Characters.

Its colour is pale smalt-blue, which sometimes passes into sky-blue, and occasionally into milk-white.

It occurs massive and disseminated.

Internally it is glistening, approaching to shining.

It displays one distinct cleavage, and another less distinct forms a right angle with it, or, according to some observers, an obtuse angle.

The fracture is splintery.

It is translucent in a low degree.

It is harder than apatite, and sometimes as hard as felspar.

It is rather difficultly frangible.

It yields a greyish-white coloured streak.

Specific gravity, 3.046, *Klaproth*.—3.060, *Karsten*.—3.0, 3.1, *Mohs*.

Chemical Characters.

Before the blowpipe it becomes white and opaque; and affords a black-coloured glass with borax.

Constituent

Constituent Parts.

Silica,	-	-	14.00
Alumina,	-	-	71.00
Magnesia,	-	-	5.00
Lime,	-	-	3.00
Potash,	-	-	0.25
Oxide of Iron,	-	-	0.75
Water,	-	-	5.00
			99.00

*Klaproth, Beit. b. iv. s. 285.**Geognostic and Geographic Situations.*

It occurs along with quartz, mica, and garnets, and probably either in the form of a bed or a mountain-mass. It is found in the valley of Murz, near Krieglach, in Stiria.

Observations.

1. This species is not very extensive, and, as far as we know at present, does not appear to be of great importance. Its essential characters are its blue colour, low degree of lustre, imperfect cleavage, inconsiderable translucency, greyish-white coloured streak, hardness, and specific gravity.

2. It is allied on the one hand to Azurite, and on the other to Compact Felspar, with which it was long confounded. It is distinguished from *Azurite* by its paler colour, inferior lustre, less perfect cleavage, splintery fracture, its chemical relations, and composition: It is distinguished from *Compact Felspar* by its blue colour, higher lustre, more distinct cleavage, slightly inferior hardness, but greater weight, and also by its chemical characters and composition.

3. Azurestone or Lapis Lazuli.

Lausurstein, *Werner*.

Sapphirus, *Plin.* Hist. Nat. xxxvii. 9. & 39.; Cyanos, *Plin.*—*Kvavos*, *Theophr.*?—Zeolithes particulis, &c. Lapis lazzuli, *Wall.* t. ii. p. 326.—Lapis lazzuli, *Romé de Lisle*, t. ii. p. 49.—Lazurstein, *Wid.* s. 371.—Lapis lazuli, *Kirw.* vol. i. p. 283.—Lapis lazzoli, *Nap.* p. 241.—Lazulite, *Lam.* t. ii. p. 185.—La pierre d'azur, *Broch.* t. i. p. 313.—Lazulite, *Haüy*, t. iii. p. 145.—Lazurstein, *Reuss*, b. ii. s. 436. *Id. Lud.* b. i. s. 91. *Id. Suck.* 1^r th. s. 423. *Id. Bert.* s. 169. *Id. Mohr*, b. i. s. 387. *Id. Hab.* s. 25.—Lazulite, *Lucas*, p. 66.—Lazurstein, *Leonhard*, Tabel. s. 16.—Lazulite, *Brong.* t. i. p. 367. *Id. Brard*, p. 164.—Lasurstein, *Haus.* s. 94. *Id. Karst.* Tabel. s. 44.—Lapis lazuli, *Kid.* vol. i. p. 244.—Lazulite, *Haüy*, Tabl. p. 47. Lasurstein, *Steffens*, b. i. s. 414. *Id. Hoff.* b. ii. s. 276. *Id. Lenz*, b. i. s. 475. *Id. Oken*, b. i. s. 355. *Id. Haus.* Handb. b. ii. s. 543.—Lapis Lazuli, *Aikin*, p. 214.

External Characters.

Its colour is azure-blue, of all degrees of intensity: the lighter varieties pass into Berlin-blue and smalt-blue; and the darker into blackish-blue. The white spots it sometimes contains, are probably owing to an intermixed mineral.

It is found massive, disseminated, and in rolled pieces.

Internally it is either glistening or glimmering.

The fracture is small and fine-grained uneven.

The fragments are indeterminate angular, and rather blunt-edged.

It

It is feebly translucent on the edges.

It scratches glass, and in some places gives a few sparks with steel.

It is easily frangible.

Specific gravity, 2.771, *Blumenbach*.—2.767 to 2.945, *Hauy*.—2.896, *Kirwan*.—2.761, *Brisson*.—2.959, *Karsten*.

Chemical Characters.

It retains its colour in a low degree of heat: in a higher heat, it melts into a blackish mass; and in a very high heat it melts into a white enamel. When pounded and calcined, it forms a jelly with acids.

It is deprived of its colour by all the mineral acids: with great rapidity by nitrous acid; less rapidity by muriatic acid; and most slowly by means of sulphuric acid.

Constituent Parts.

Silica,	-	-	46.00
Alumina,	-	-	14.50
Carbonate of Lime,	-	-	28.00
Sulphate of Lime,	-	-	6.50
Oxide of Iron,	-	-	3.00
Water,	-	-	2.00

100

Klaproth, b. i. s. 196 *

Geognostic

* The older chemists were of opinion, that the beautiful colour of this mineral was owing to copper; but it is now known that iron is the only colouring principle it contains.

Geognostic Situation.

Its geognostic situation is still imperfectly known. It appears sometimes to occur in primitive limestone, along with iron-pyrites, in Persia, Tartary and China; in veins that traverse granite, along with quartz, mica, and iron-pyrites in the Altain mountains; and at the southern end of the Lake Baikal in Siberia, in a vein, associated with garnets, mica, felspar, and iron-pyrites.

Geographic Situation.

It is found in Persia, Bucharia, China, Great Tartary, and Siberia. Mr Pennant, in his *Outlines of the Globe*, informs us, that it is found in considerable quantities in the Island of Hainan in the Chinese sea, from whence it is sent to Canton, where it is employed in china painting.

Uses.

On account of its beautiful blue colour, and the fine polish it is capable of receiving, it is much prized by lapidaries, and is cut as ring-stones, seal-stones, vases, snuff-boxes, and other ornamental articles of the same nature: it is also used in mosaic and Florentine work. It is highly valued by painters, on account of the fine ultramarine blue colour obtained from it.

The whole art in preparing this colour, consists in freeing the azurestone from all impurities, and reducing it to an extremely fine powder. This is done in the following manner: The azurestone is first reduced to a coarse powder, and then exposed for an hour in a crucible to a pretty strong heat. Vinegar is then poured on it, and the whole is allowed to stand for some days: at the end of

this time, the vinegar is poured off, and the powder is still further comminuted, by rubbing in a glass mortar. The roasting or calcination of the azurestone must be repeated one or more times, if the first heating has not rendered it so friable as to allow of its being reduced to a sufficiently fine powder. The powder is now to be repeatedly washed with water, in order to free it from the vinegar with which it is combined, and then to be ground on a stone of porphyry or agate, until it is rendered completely impalpable. It is next to be thrown into a melted mixture of pitch, wax, and linseed oil, and carefully mixed with it, and then allowed to cool. Tepid water is next to be poured on this mixture, and the whole is to be well triturated by means of a pestle: the water becomes muddy, and is to be poured off; fresh water is to be added which very soon assumes a beautiful blue colour. When this water is sufficiently saturated, it is poured off, fresh water is added to the mixture, and soon assumes a blue colour, but of a paler tint than the former, and this process is repeated, until the water becomes only of a dirty grey colour. A powder is deposited from each of these ablutions, and the beauty of its colour depends on the purity of the azurestone and the ablution itself, the first always affording the finest and richest colour. The foreign parts remain combined with the cement. It was formerly an article of the materia medica, and was therefore kept in apothecaries' shops; but very often its place was supplied by azure copper-ore, mixed with limestone, which was named *Armenian Stone*.

Observations.

1. This mineral is distinguished by its colour, low degree of lustre, fracture, its low degree of translucency on the

the edges, its hardness, and geognostic situation. It has been confounded with Azure Copper-Ore; but it differs from that mineral in lustre, fracture, hardness, and geognostic situation.

2. Azurestone was well known to the Greeks and Romans, under the name of *Sapphire*: when it contained much disseminated iron-pyrites, it was then called *Sapphirus regius*, because the pyrites was supposed to be gold.

3. It is generally known under the name *Lapis lazuli*: Lazulus is derived from the Arabian word *azul*, the heaven, and refers to the fine blue colour of this mineral. The name *Ultramarine*, given to the fine pigment obtained from azurestone, is said to have been bestowed on it on account of its having been brought into Europe from beyond the sea.

4. Calaite, or Mineral Turquoise.

Calaite, seu Borea, *Plin. Hist. Nat. lib. xxxvii. cap. 8. Id. Fischer, Mem. de la Soc. Imper. des Naturalistes de Moscow, vol. i. p. 149.*—Turcosa, *Fischer, Onomast. (1811), p. 53.*—Turkis, *Ullmann, Mineral. einf. Fossilien, p. 76. n. 103.*—Dichter Hydrargilite, *Haus. Handb. b. ii. s. 444.*—Calaite, *Fischer, Essai sur la Turquoise, et sur la Calaite, 1816, Moscow.*

External Characters.

Its colours are smalt-blue, sky-blue, apple-green, and pistachio-green; in specimens which have been exposed to the weather, the colours are celandine-green, siskin-green, and greenish-yellow.

It occurs massive, disseminated, reniform, and botryoidal.

Internally

Internally it is dull, or feebly glistening and resinous.

Its fracture is imperfect conchoidal, or coarse-grained uneven.

The fragments are indeterminate angular, and sharp-edged.

It is opaque, and very rarely feebly translucent on the edges.

It is harder than felspar, but softer than quartz.

Its streak is white.

Specific gravity 2.860, 3.0, *Fischer*.

Constituent Parts.

Alumina,	-	-	73.
Oxide of Copper,	-	-	4.50
Water,	-	-	18.
Oxide of Iron,	-	-	4.
Loss,	-	-	0.50
			<hr/>
			100

John, in *Fischer's Essai sur la Turquoise*, p. 27.

Geognostic Situation.

It occurs in veins in clay ironstone, and also in small pieces in alluvial clay.

Geographic Situation.

It has hitherto been found only in the neighbourhood of Nichabour in the **Khorasan** in Persia.

Uses.

Uses.

It is very highly prized as an ornamental stone in Persia and the neighbouring countries. Although it is opaque, comparatively soft, and does not admit of a high polish, yet its agreeable colours and rarity have procured for it, even in Europe, a considerable rank among the gems. In Europe, it is cut in flat *cabochon*, and is used for ring-stones and ear-drops; it is sometimes surrounded with diamonds, and is generally set in gold. In Persia and Turkey, it is used for head-dresses, bracelets, and ring-stones, with or without diamonds; and is also much employed in ornamenting the handles of sabres and stilettoes. In Persia, it is a favourite material for talismans. It is sometimes imitated in paste; but these artificial turquoises are readily distinguished from the true, by their higher lustre, and greater brittleness.

Observations.

At first sight this mineral might be confounded with Malachite; but a very simple character distinguishes them, —malachite yields a green streak, whereas that of calaite is white.

SAPPHIRE.

Fig. 25.

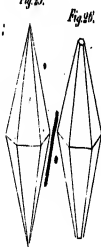


Fig. 28.

Fig. 29.

Fig. 30.

Fig. 31.

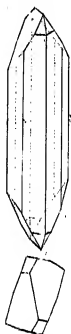
Fig. 32.

TOPAZ.

Fig. 33.

TOPAZ.

Fig. 34.



ECCLASE

Fig. 38.

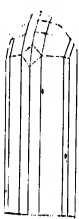


Fig. 35.



Fig. 36.



Fig. 37.

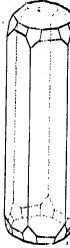


Fig. 39.



BERYL.



TOURMALINE.

Fig. 43.



Fig. 44.



Fig. 45.

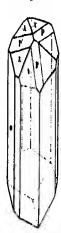


Fig. 46.



Fig. 47.

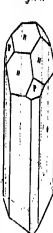
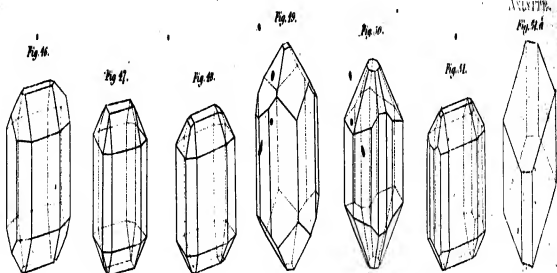


Fig. 48.



Fig. 49.

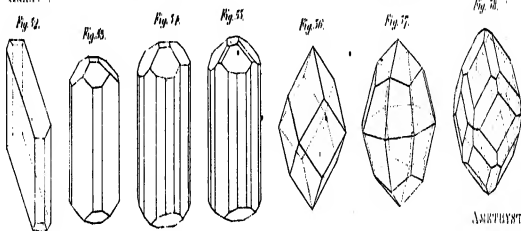




ANALYSE.

VESTIVAN.

GARNET.



AMETHYST.

GRENATITE.

GARNET.

Fig. 59.

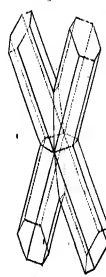
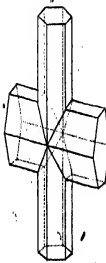
Fig. 60.

Fig. 61.

Fig. 62.

Fig. 63.

Fig. 64.



E. H. H. H.

ROCK CRYSTAL.

Fig. 66.



Fig. 68.

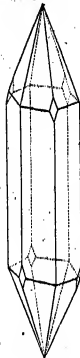
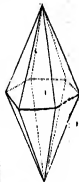


Fig. 69.



Fig. 67.



PRAENITE.

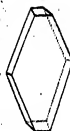
Fig. 70.



Fig. 71.



Fig. 72.



NEEDLE ZEBOLITE.

Fig. 73.



Fig. 74.



RADIATED ZEBOLITE.

Fig. 75.



FOLIATED ZEBOLITE.

Fig. 76.



Fig. 77.



Fig. 78.

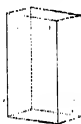
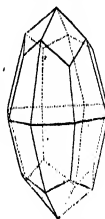


Fig. 79.



CURICITE.

Fig. 80.



CHARASITE.

Fig. 81.



CROSS STONE.

Fig. 84.

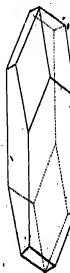


Fig. 85.

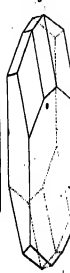


Fig. 86.



Fig. 87.

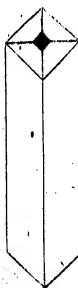
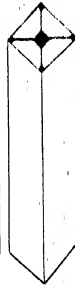


Fig. 88.



CHIASTOLITE.

Fig. 89.



CHARASITE.

Fig. 82.

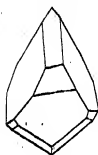


Fig. 83.

